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ABSTRACT

This study was conducted at the request of the Water and Chemicals Division of Alberta Environment. The purpose of the project was to find a long-term groundwater source for the hamlet of Duvernay.

GROUNDWATER EXPLORATION AND TESTING - DUVERNAY AREA

Test drilling was conducted at a site near the hamlet to determine the water supply potential in the sandstone beds (Brossseau Formation) of the non-marine Belly River Formation. The underlying marine Lee Park Formation is not considered to contain a sufficient amount of potable groundwater for use by the hamlet.

A site, 1.7 km to the southwest of the hamlet was found to have the potential to supply the hamlet with a sufficient amount of groundwater. The chemical analysis of the water indicates the groundwater has a total dissolved solids content of approximately 300 mg/l.

ALBERTA ENVIRONMENT WATER RESOURCES MANAGEMENT SERVICES TECHNICAL SERVICES DIVISION HYDROGEOLOGY BRANCH

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May, 1988

Submitted by:

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Branch Head
Hydrogeology Branch

ABSTRACT

This study was conducted at the request of the Wastes and Chemicals Division of Alberta Environment. The purpose of the project was to find a long-term groundwater source for the Hamlet of Duvernay.

Test drilling was conducted at six sites south of the hamlet to determine the water supply potential in the sandstone beds (Brosseau Tongue) of the non-marine Belly River Formation. The underlying marine Lea Park Formation is not considered to contain a sufficient amount of potable groundwater for use by the hamlet.

A site, 1.7 km to the southwest of the hamlet was found to have the potential to supply the hamlet with a sufficient amount of groundwater. The chemical analysis of the water indicates the groundwater has a total dissolved solids content of approximately 900 mg/l.

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ABSTRACT

This study was conducted at the request of the Water and Land
Division of Alberta Environment. The purpose of the project was to find
a long-term groundwater source for the Municipality of Cochrane.
Test drilling was conducted at six sites south of the town to
determine the water level potential of the aquifers. The results of the
drilling of the non-saline Kelly River Formation. The results of the
test drilling are not considered to contain a sufficient amount of
information to be used by the Municipality.
A water table to the southwest of the tested area found to have the
potential to supply the town with a sufficient amount of groundwater.
The physical analysis of the water indicated the groundwater was a hard
discovery of this content of approximately 500 mg/L.

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INTRODUCTION

At the request of the Wastes and Chemicals Division, a test drilling program was conducted to find a long-term groundwater supply for approximately 40 people in the Hamlet of Duvernay.

The Hamlet of Duvernay is situated approximately 115 km east of Edmonton and 10 km north of Two Hills in LSD 16 of Section 27 and LSD 1 of Section 34 Township 55 Range 12 West of the Fourth Meridian. The hamlet is on the southern bank of the North Saskatchewan River. The topography increases in terraces from an elevation of 540 m a.m.s.l. at Duvernay to 587 m a.m.s.l. 3 km south of Duvernay.

Hydrogeological reports and water well drillers reports were reviewed to determine the hydrogeologic environment, then a test drilling program was conducted at six sites within 3 km of the Hamlet (Figure 1). In cooperation with the County of Two Hills, the six sites were drilled, electric logged and the aquifers tested for yield and sampled for water chemistry.

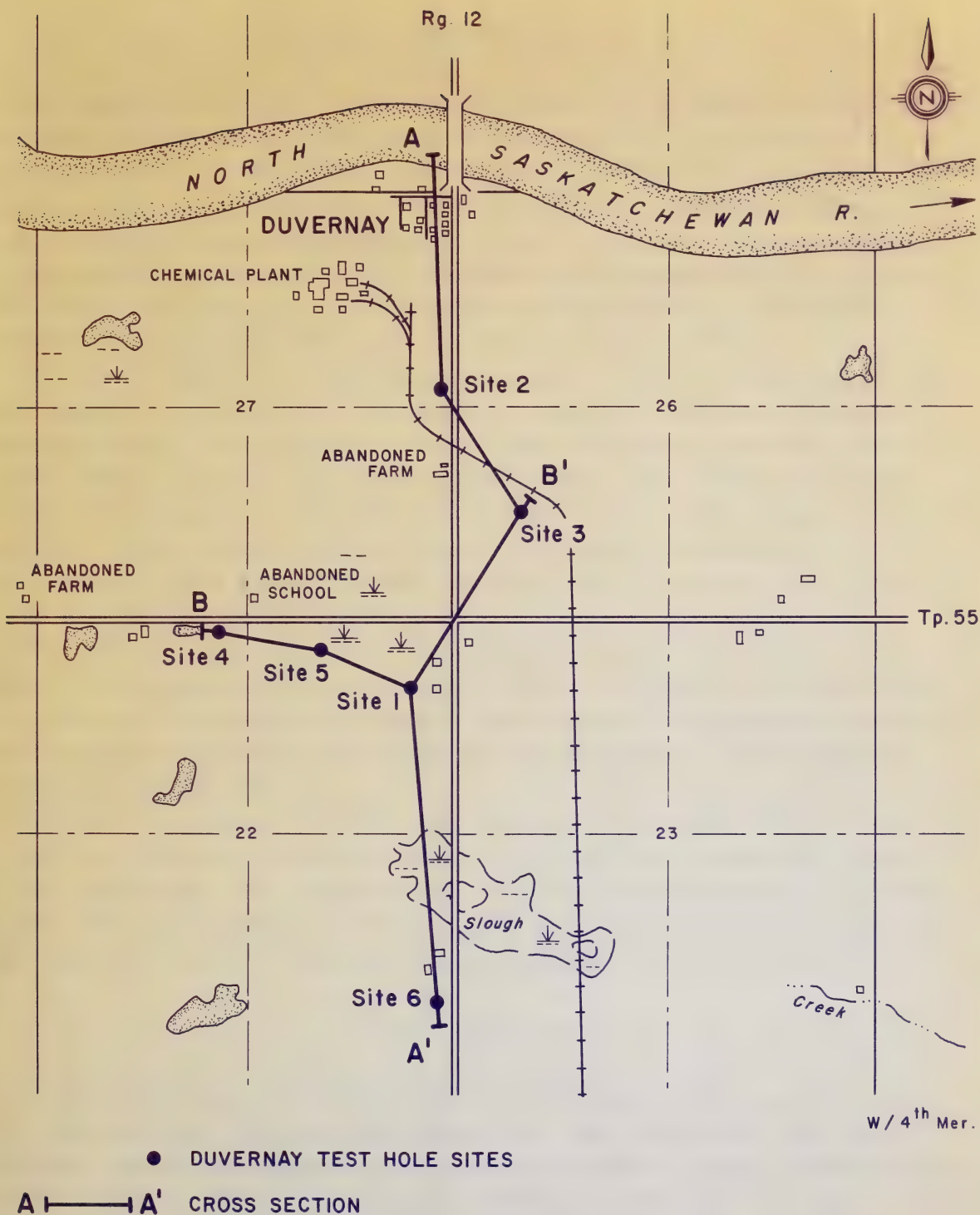


Figure 1
GROUNDWATER EXPLORATION — DUVERNAY
LOCATION PLAN

HYDROGEOLOGY

The uppermost bedrock in the area is the Upper Cretaceous Belly River Formation ranging in thickness from a few metres at the hamlet of Duvernay to 40 m at the higher elevations 2 km south of the hamlet. The hydrogeological cross sections (Figure 2) show the sandstone beds are thin close to Duvernay and to the east and tend to increase in thickness to the southwest. The base of the Formation is approximately 525 m a.m.s.l. (1725 ft.). The Formation is non-marine and consists of interbedded feldspathic sandstone, siltstone, and shale (Green, 1972).

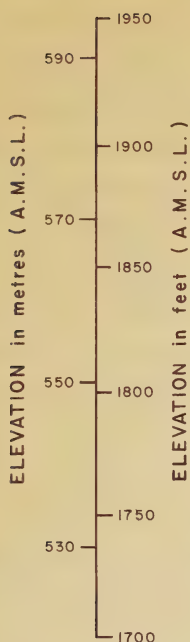
The sandstone beds of the Brosseau Tongue of this formation are the major source of groundwater for domestic supply in the area south of Duvernay (Currie and Zackarko, 1976). The groundwater chemistry of the aquifer water indicates it is quite mineralized with total dissolved solids ranging from 900 to 1800 mg/l. Some wells in the region have sulphates and/or nitrates which exceed the maximum acceptable concentrations (Health and Welfare Canada, 1987). The water is of the sodium bicarbonate sulphate type.

The Lea Park Formation underlies the Belly River Formation. The deposition is marine and is composed of shale and silty shale with some thin fine grained sandstone lenses. Groundwater yields are very low from these sandstones ranging from a few gallons per day to 2 gallons per minute (Le Breton, 1965).

Bedrock is covered by drift that ranges in thickness from 1 m to 12 m and is comprised predominantly of till with thin sand beds present at some locations. The residents of Duvernay currently use dug or bored seepage wells in the shallow drift aquifers. The Belly River Formation sandstones have been eroded and are not present after the hamlet.

TEST DRILLING

South of Duvernay, within 3 km of the hamlet, a total of six test holes were drilled and one observation well was installed. The test holes were cased when necessary, to obtain potential yield rates from the sandstone beds. The aquifers were tested by compressor air lift, and the flow rate periodically measured throughout the test. The recovery rate was then recorded to obtain transmissivity and the twenty year well yield. All test holes were electric logged then abandoned and sealed with Benseal.



A

NORTH SASKATCHEWAN RIVER

DUVERNAY

SITE 2 (2485E)

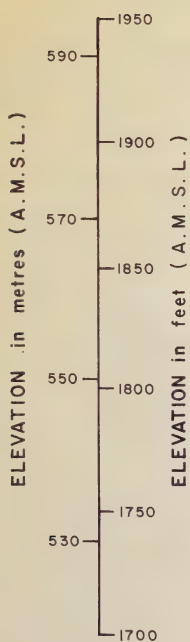
LSD 9-27-55-12-W4M

ss
sh
ss
sh

SITE 3 (2486E)

LSD 5-26-55-12-W4M

ti
sd
gvl
ss
sh
ss
sh
sh
sh



B

SITE 4 (2487E)

LSD 14-22-55-12-W4M

ti
sh
ss
sh

SITE 5 (2488E T.H.)

(2489E Well)

LSD 15-22-55-12-W4M

ti
sh
ss
sh
ss
sh
sh
sh
sh

SITE 1 (2484E)

LSD 16-22-55-12-W4M

sd
ti
sh
ss
sh
ss
sh
ss
sh
sh

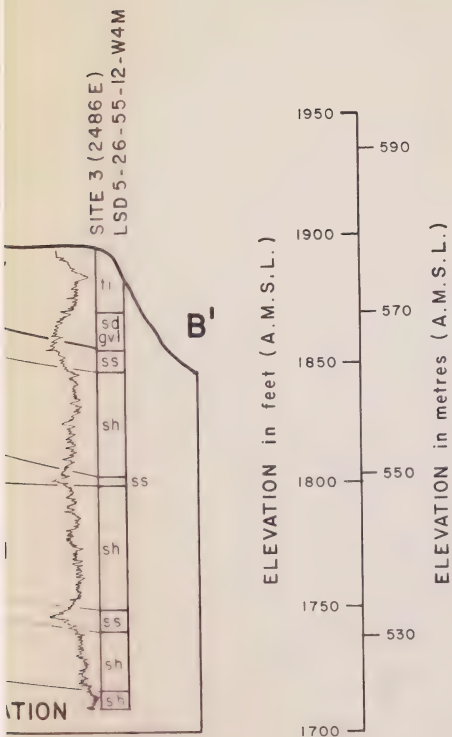
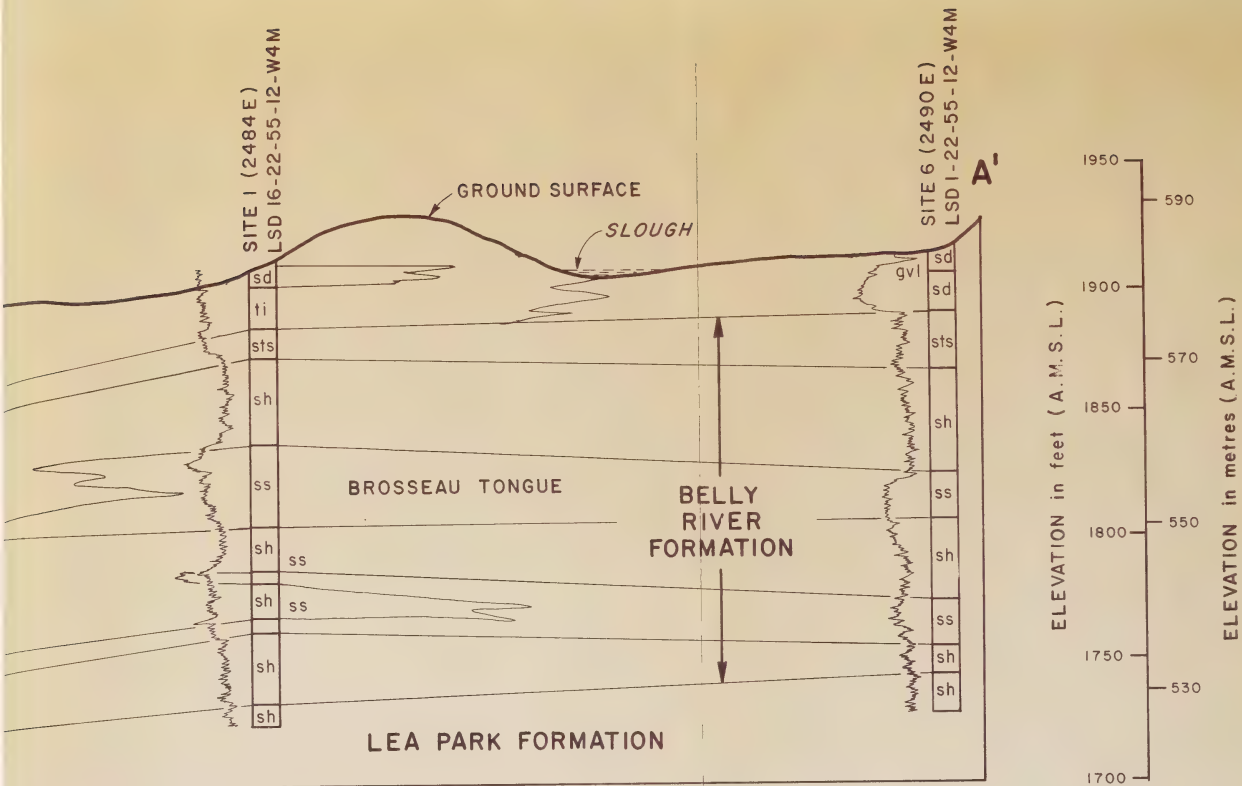
GROUND SURFACE

QUATERNARY

BROSSEAU TONGUE

BELLY RIVER FORMATION

LEA PARK FORMATION



LEGEND

- ss - sandstone
- sts - siltstone
- sh - shale
- ti - till
- sd - sand
- gvl - gravel
- FORMATION, TONGUE BOUNDARY

Figure 2
HYDROGEOLOGIC CROSS SECTIONS

Site #1

At LSD 16-22-55-12-W4M a test hole was drilled to 55 m which penetrated the entire Belly River Formation and 3 m of the Lea Park Formation (Appendix A). A sandstone aquifer, the Brosseau Tongue of the Belly River Formation, was encountered from 22 to 31 meters below ground surface. The upper portion of the hole was cased to 13 m, then the aquifer was air tested. It produced about 11 L/min. (2.5 igpm) initially and improved to between 14-18 L/min. (3-4 igpm). A water sample was analysed by the Alberta Environment Lab in Lethbridge. The results are shown in Table 1. The water is quite mineralized with a total dissolved solids content of 968 mg/l. The sodium adsorption ratio (S.A.R.) is very high, (Table 1, Appendix C). The water is of the sodium bicarbonate type.

Site #2

At LSD 9-27-55-12-W4M a test was drilled to 30 m. This well encountered sandstone from 16-21 m however the air test yielded only 2-3 L/min. (0.5 to .75 igpm).

Site #3

At LSD 5-26-55-12-W4M a test hole was drilled to 54 m encountering sandstone from 12-14 m, 26-27 and 42-45 m. Each sandstone was air tested, however the yield did not exceed 4.5 L/min. (1 igpm).

Site #4

At LSD 14-22-55-12-W4M a test hole was drilled to 33 m and cased to 20 m. A sandstone aquifer was found between 20-32 m from ground surface and air tested indicating a yield from 55-70 L/min. (12-15 igpm). Two water samples were taken; one during the test and the other 3 days later. The chemical analysis indicates the water is quite mineralized with a total dissolved solids content of 943 mg/l. This water was similar to that of site 1. The iron concentration was much lower. The S.A.R. was still very high.

TABLE 1: GROUNDWATER CHEMICAL QUALITY*1

PARAMETER	MAXIMUM	SITE 1	SITE 4	SITE 4	SITE 5
	ACCEPTABLE CONCENTRATION*	<u>16-22-55-12-4</u>	<u>14-22-55-12-4</u>	<u>14-22-55-12-4</u>	<u>15-22-55-12-4</u>
Source		Cased testhole	Cased testhole	Cased testhole	Observation Well
Sample Date		April 27, 1988	April 29, 1988	May 2, 1988	May 5, 1988
Calcium	---	15	7	10	12
Magnesium	---	5	1	2	3
Hardness, total CaCO ₃	---	58	24	32	43
Chloride	---	363	363	338	359
Potassium	---	5	3	3	4
Bicarbonate	---	23	19	0	20
Carbonate	---	762	708	659	722
Alkalinity, Total CaCO ₃	---	663	612	540	625
pH	---	1.89	<0.01	0.40	0.51
Fluoride	1.5	0.71	0.40	0.10	0.68
Phosphate	500	143	168	181	157
Nitrate	---	37	33	29	37
Nitrate & Nitrite N	10	<0.07	<0.07	<0.07	<0.07
Ammonium N	---	1.79	1.01	1.4	1.75
Total Dissolved Solids	---	968	943	889	949
Electric Conductivity* ⁵		1.55	1.51	1.45	1.54
* ³	---	8.40	8.40	8.07	8.46
adium Adsorption Ratio* ³	6* ⁴	20.8	32.6	26.2	23.9

- Unless specified otherwise
- Guidelines for Canadian Drinking Water Quality 1987
- Dimensionless
- McNeeley et al (1979)
- Deci Siemens/m

Site #5

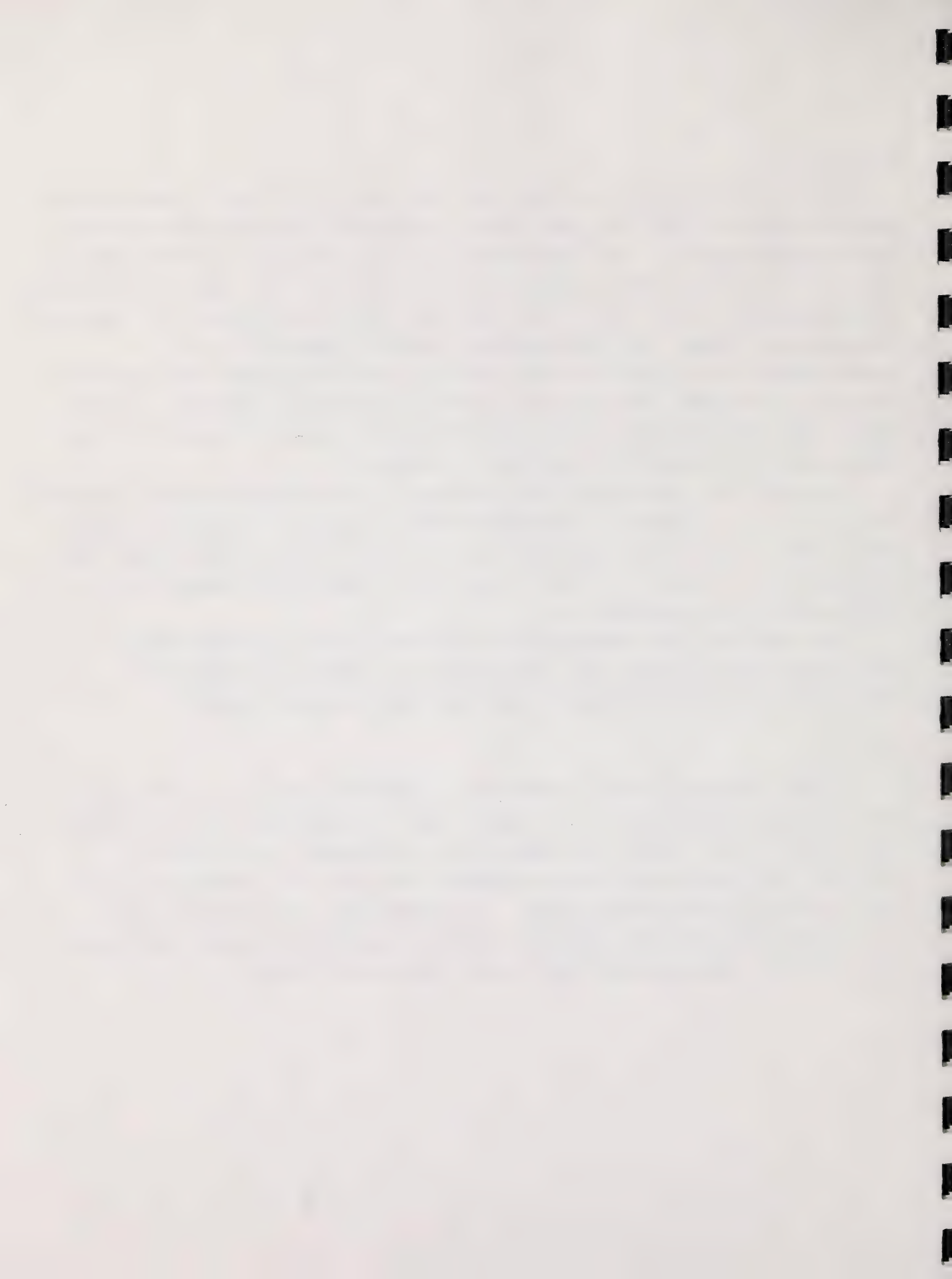
At LSD 15-22-55-12-W4M a test hole was drilled to 49 m. An air test yielded about 27 L/min (6 igpm) from a sandstone aquifer from 17-26 m below ground surface. An observation well was installed in this aquifer and a two hour pump test, with a two hour recovery test, had a calculated transmissivity of $10.6 \text{ m}^2/\text{d}$ (709 igpd/ft) and a twenty year well yield of 30 L/min (6.6 igpm) from the pumping interval (Appendix B). A transmissivity of $7.65 \text{ m}^2/\text{d}$ (513 igpd/ft) and twenty year well yield of 22 L/min (4.8 igpm) was calculated from the recovery interval. A water sample was collected during the pump test for analysis (Table 1). The water quality is similar to the site 4 samples.

This well was constructed by cementing 14 cm diameter steel casing to 16.6 m. A 1.5 m length of stainless steel 7 slot well screen was sand packed with 12-20 sieve frac sand from 18.9 to 20.6 m. The screen was attached to 3.7 m of 11 cm riser pipe and a lead packer wedged to the casing at 15.2 m (Appendix D).

This well will be incorporated into the Provincial Groundwater Observation Well Network for the purpose of monitoring hydraulic fluctuations and hydrochemistry over the next several years.

Site #6

At LSD 1-22-55-12-W4M a test hole was drilled to 55 m. This test hole encountered gravel to 3 m then a sand or sandstone to 6 m. Casing was set to 6 m to enable air testing of a sandstone from 27-33 m. However, when an air test was attempted, it blew out saturated sand as well as breaking the casing seal. The casing seal was regained by packing the annulus with Benseal. Another sandstone aquifer was present from 41-48 m, however this hole could not be air tested.

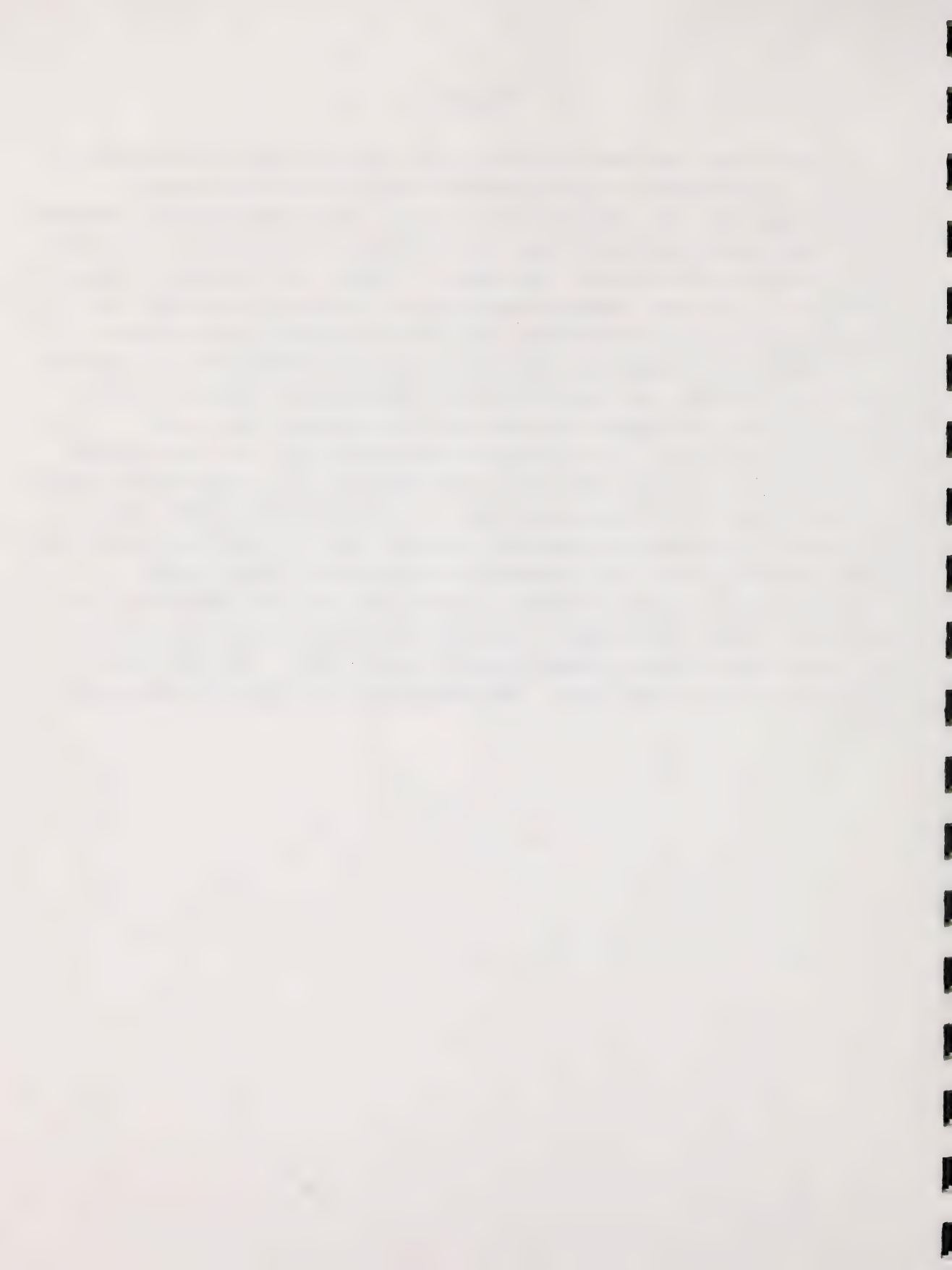


CONCLUSIONS

Six test holes and one observation well were drilled to the south of Duvernay. The Brosseau Tongue sandstone beds of the Belly River Formation are the main aquifers of the area. Groundwater yields obtained by air testing the aquifers ranged from 2 L/min. (0.5 igpm) 0.6 km south of Duvernay to up to 70 L/min (15 igpm) 1.7 km to the southwest. This latter site, (site #4) produced between 55 to 70 L/m (12-15 igpm) of water from a 12 m thick sandstone from 20-32 m below ground surface..

A groundwater monitoring observation well was installed 0.4 m east of site 4 for inclusion into the Provincial Groundwater Observation Well Network. A two hour pump test and a two hour recovery test were performed on the well. The calculated transmissivity from the pumping interval of the test was $10.6 \text{ m}^2/\text{d}$ (709 igpd/ft) with a calculated twenty year well yield of 30 L/min (6.6 igpm). It is anticipated that the transmissivity and twenty year well yield at site 4 would be considerably higher because the air test yielded twice the flow rate of water.

Water samples collected from two test holes and the observation well indicated similar water types. The water is quite mineralized, with the total dissolved content ranging from 889 to 968 mg/l, and the sodium adsorption ratio is very high. The water is of the sodium bicarbonate type.



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- Green, R. (1972): Geological Map of Alberta; Research Council of Alberta, Map 35, Scale 1 inch to 20 miles.
- Health and Welfare Canada (1987): Guidelines for Canadian Drinking Water Quality; Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Canada.
- LeBreten, E.G. (1963): Groundwater Geology and Hydrology of East-Central Alberta; Research Council of Alberta, Bulletin 13.
- McNeely, R.N., V.P. Neimanis and L. Dwyer (1979): Water Quality Sourcebook, A Guide to Water Quality Parameters; Environment Canada, Inland Waters Directorate, Water Quality Branch, Ottawa.

APPENDIX A

GEOPHYSICAL LOGS

ALBERTA ENVIRONMENT HOLE #2484E
(DUVERNAY #1)
LSD 16-22-55-12W4M

ELEV. 1910' amsl.

<u>DEPTH</u> <u>(feet)</u>	<u>LITHOLOGY</u>
0 - 2	sandy topsoil
2 - 8	sand, coarse grained
8 - 16	till soft pebbly brown
16 - 22	till harder pebbly grey
22 - 24	sand coarse grained
24 - 72	shale dark grey
72 - 75	sandstone light grey soft bentonitic
75 - 82	sandstone hard light brown
82 - 84	sandstone softer light brown
84 - 102	sandstone softer light grey
102 - 118	shale
ran gamma, SP and PR logs	
cased off surficial 42'	
air lifted aquifer 2.5 igpm	
blew 1 hour	
stopped blowing 12:52 pm	
w.l. 21:30 @ 12:59 pm	
15:12 @ 1:16 pm	
14:74 @ 1:19 pm	
14:52 @ 1:22 pm	
14:31 @ 1:24 pm	
14:17 @ 1:26 pm	
13:93 @ 1:32 pm	
conductivity 1000 umhos	
118 - 120	sandstone light grey
120 - 137	shale light grey
137 - 143	shale hard brown some good siltstone (brown)
	cuttings after hard ledge
143 - 147	sandstone light grey
147 - 178	shale hard ledge at 170'

Hole electric logged and gamma ray logged and sealed with BenSeal.

GEOPHYSICAL LOG		 Alberta ENVIRONMENT EARTH SCIENCES DIVISION GROUNDWATER BRANCH		<input checked="" type="checkbox"/> POINT RESISTANCE <input checked="" type="checkbox"/> SPONTANEOUS POTENTIAL <input type="checkbox"/> NORMAL RESISTIVITY <input type="checkbox"/> GAMMA <input type="checkbox"/> CASING COLLAR LOCATOR <input type="checkbox"/> TEMPERATURE GRADIENT <input type="checkbox"/> DELTA TEMPERATURE <input type="checkbox"/> MUD CELL		PROJECT _____
OXBRIDGE PLACE 9820-108 ST. EDMONTON, ALBERTA T5K 2J8		PROJECT <u>GROUNDWATER EXPLORATION</u> AREA <u>DUFFERIN</u> WELL <u>TEST HOLE No 1</u> LOCATION <u>LSD 16-22-55-12-W4M</u>		NTS MAP REFERENCE <u>73E13</u> G.L. ELEVATION <u>1920'</u>		WELL _____ LOCATION _____
		Run No 1	Run No 2	MUD	Run No 1	Run No 2
Date	1988-04-22	1988-04-22		Nature	<u>Natural / 1 lb Bentonite Quik Gel</u>	
First Reading	117'			Density		
Last Reading	21'			Viscosity		
Footage Logged	96'			Resistivity		
T.D. (Driller)	120'			Circ Temp		
Bit Size	5/8"			pH		
Casing Size						
Interval						
Bit Size						
Casing Size						
Interval						
				Logged by	<u>S. Clace</u>	
				Witnessed by	<u>M. Cherniawchan</u>	
REMARKS <u>Logging Speed 60'/min</u>				NOTE: <u>Logged PRIOR TO CASING TO 1142 FT.</u>		
S. P.				P. R.		
2 mV/CD				5 m/CD		

GEOPHYSICAL LOG

OXBRIDGE PLACE
9820-108 ST.
EDMONTON, ALBERTA
T5K 2J6

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- ☐ POINT RESISTANCE
- ☐ SPONTANEOUS POTENTIAL
- ☐ NORMAL RESISTIVITY
- ☒ GAMMA
- ☐ CASING COLLAR LOCATOR
- ☐ TEMPERATURE GRADIENT
- ☐ DELTA TEMPERATURE
- ☐ MUD CELL

PROJECT _____
WELL _____
LOCATION _____

PROJECT GROUNDWATER EXPLORATION

AREA DUVERNOY

WELL TEST HOLE #1

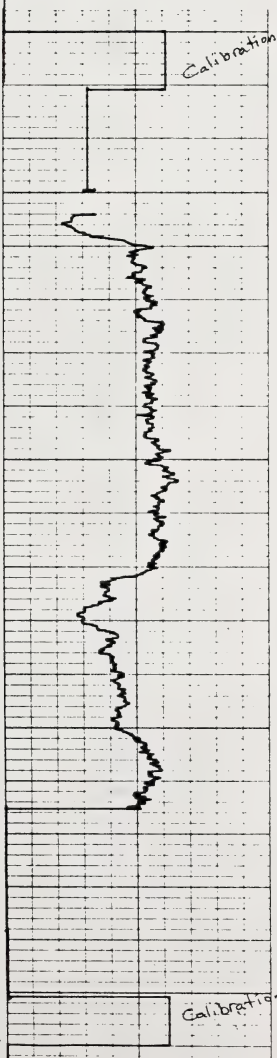
LOCATION LSD 16-22-55-12 W4M

NTS MAP REFERENCE 73E/13
O.L. ELEVATION 1920'

	Run No 1	Run No 2	MUD	Run No 1	Run No 2
Date	1988-04-27		Nature	Natural / 1 bag Quik Gel	
First Reading	11.5'		Density		
Last Reading	4'		Viscosity		
Footage Logged	111'		Resistivity		
T.D. (Driller)	120'		Circ Temp		
Bit Size	5 7/8"		pH		
Casing Size					
Interval					
Bit Size					
Casing Size					
Interval					
			Logged by	S. Clace	
			Witnessed by	M. Chernowchan	

REMARKS Logging Speed 12'/min.
Time Constant 3 sec
Calibration 6.1 API

NOTE: LOGGED PRIOR TO
CASING TO 42 FT.



GEOPHYSICAL LOG <small>OXBRIDGE PLACE 8820-106 ST EDMONTON, ALBERTA T5K 2J8</small>		 ALBERTA ENVIRONMENT <small>EARTH SCIENCES DIVISION GROUNDWATER BRANCH</small>		<input checked="" type="checkbox"/> POINT RESISTANCE <input checked="" type="checkbox"/> SPONTANEOUS POTENTIAL <input checked="" type="checkbox"/> NORMAL RESISTIVITY <input type="checkbox"/> GAMMA <input type="checkbox"/> CASING COLLAR LOCATION <input type="checkbox"/> TEMPERATURE GRADIENT <input type="checkbox"/> DELTA TEMPERATURE <input type="checkbox"/> MUD CELL		PROJECT _____ WELL _____ LOCATION _____
PROJECT <u>GROUNDWATER EXPLORATION</u> AREA <u>DUYERNAY</u> WELL <u>TEST HOLE No. 1</u> LOCATION <u>LSD 16-22-55-12 W4M</u>			NTS MAP REFERENCE <u>73E/13</u> G.L. ELEVATION <u>1920'</u>			
	Run No 1	Run No 2	MUD	Run No 1	Run No 2	
Date		1988-04-27	Nature	Natural / log gel		
First Reading		178'	Density			
Last Reading		41'	Viscosity			
Footage Logged		137'	Resistivity			
T.D. (Driller)		180'	Circ Temp			
Bit Size		6 7/8"	pH			
Casing Size		5 9/16"				
Interval		0-42'				
Bit Size		5 1/8"				
Casing Size		OPEN				
Interval		42-178'				
			Logged by	S. Clark		
			Witnessed by	M. Chernowchan		
REMARKS <u>LOGGING SPEED 60'/min</u>						
<div style="display: flex; justify-content: space-between;"> S. P. <u>2 mV/CD</u> P. R. <u>5 m/CD</u> </div>						

GEOPHYSICAL LOG

BOREHOLE PLACE
SECTION 10
TOWNSHIP 10N
RANGE 10W

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- ☐ POINT RESISTANCE
- ☐ SPONTANEOUS POTENTIAL
- ☐ APPARENT RESISTIVITY
- ☒ GAMMA
- ☐ GAMMA RAY LOG (GRL)
- ☐ TEMPERATURE GRADIENT
- ☐ DELTA TEMPERATURE
- ☐ MUD CELL

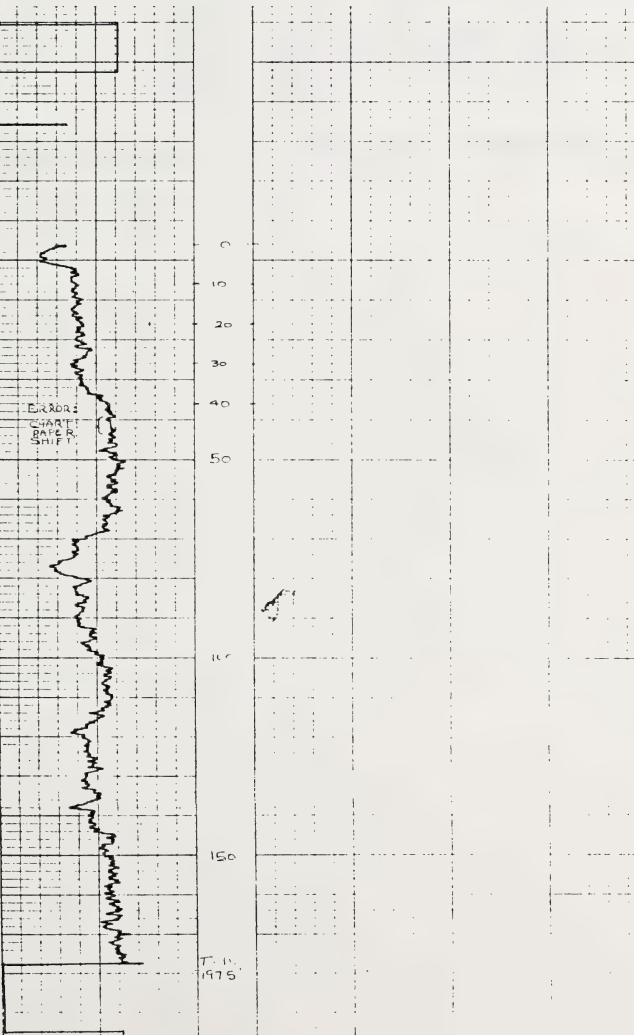
PROJECT: _____
WELL: _____
LOCATION: _____

PROJECT: GROUNDWATER EXPLORATION
AREA: DUVERNAY
WELL: TEST HOLE #1
LOCATION: 14-22-55-12-W4M

HTS MAP REFERENCE: 73E/13
O.L. ELEVATION: 1920'

	Run No. 1	Run No. 2	Run No. 3	Run No. 4
Date		1986-04-27		
First Reading		197.5	Natural 1.19g/gal	
Last Reading		0		
Footage Logged		197.5		
T.D. (Drillbit)		240		
Bit Size		6 3/4"		
Casing Size		8 7/8"		
Interval		0-42'		
Bit Size		5 7/8"		
Casing Size		5 1/2"		
Interval		42-178'		
Logged By		S. Elara		
Witnessed By		M. Cunningham		

REMARKS: Logging Speed 12"/min
Time Constant 3 sec
Calibration 6.1 API



ALBERTA ENVIRONMENT HOLE #2485E
(DUVERNAY #2)
LSD 9-27-55-12W4M

ELEV. 1840' amsl.

DEPTH (feet)	LITHOLOGY
0 - 2	sandy topsoil
2 - 12	sandstone orange-yellow oxidized
12 - 16	sandstone grey, soft
16 - 18	shale fractured brittle tan color
18 - 21	sandstone
21 - 48	shale brown sandstone seam around 45 ft.
48 - 53	shale
53 - 68	sandstone soft light grey
68 - 78	shale brown air test from 1/2 to 3/4 igpm
78 - 98	shale grey

Hole electric logged and gamma ray logged and sealed with BenSeal.

GEOPHYSICAL LOG

OXBRIDGE PLACE
9820-106 ST.
EDMONTON, ALBERTA
T5N 2J8

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

☒ SPONTANEOUS POTENTIAL
☐ NORMAL RESISTIVITY
☐ GAMMA
☐ CASING COLLAR LOCATION
☐ TEMPERATURE GRADIENT
☐ DELTA TEMPERATURE
☐ MUD CELL

PROJECT _____
WELL _____
LOCATION _____

PROJECT GROUNDWATER EXPLORATION

AREA Duveray

WELL TEST HOLE No 2

LOCATION LSD 9-27-55-12 W4M

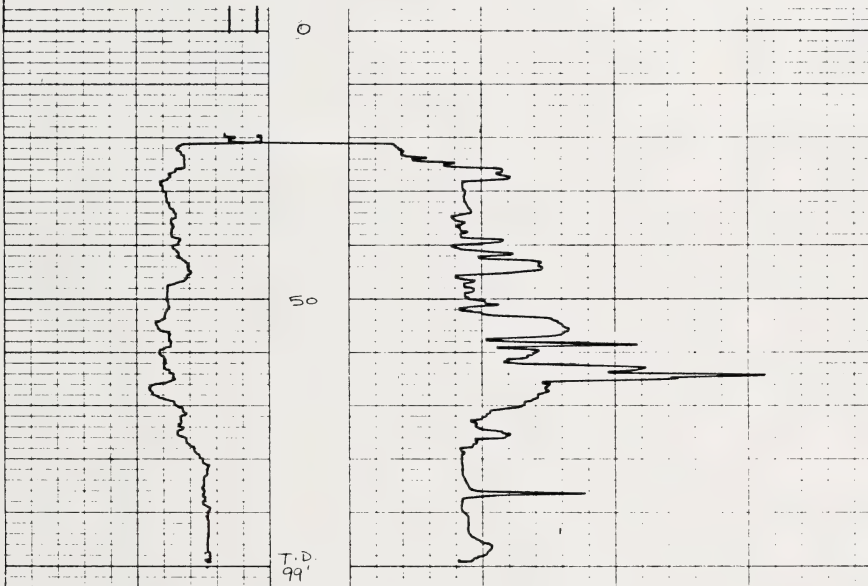
NTS MAP REFERENCE 73L/13
G.L. ELEVATION 1840'

	Run No 1	Run No 2	MUD	Run No 1	Run No 2
Date	1988-04-28		Nature	Natural	
First Reading	99'		Density		
Last Reading	21'		Viscosity		
Footage Logged	78'		Resistivity		
T.D. (Driller)	100'		Circ Temp		
Bit Size	5 1/2"		pH		
Casing Size					
Interval					
Bit Size					
Casing Size					
Interval					
			Logged by	S. Clare	
			Witnessed by	M. Cherniwchan	

REMARKS Logging Speed 60'/min

S.P.
2mV/CD

P.R.
2m/CD



OXBRIDGE PLACE
9820-106 ST.
EDMONTON, ALBERTA
T5K 2J6

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- | | |
|-------------------------------------|------------------------|
| <input type="checkbox"/> | POINT RESISTANCE |
| <input type="checkbox"/> | SPONTANEOUS POTENTIAL |
| <input type="checkbox"/> | NORMAL RESISTIVITY |
| <input checked="" type="checkbox"/> | GAMMA |
| <input type="checkbox"/> | CASING COLLAR LOCATION |
| <input type="checkbox"/> | TEMPERATURE GRADIENT |
| <input type="checkbox"/> | DELTA TEMPERATURE |
| <input type="checkbox"/> | MUD CELL |

PROJECT _____

WELL _____

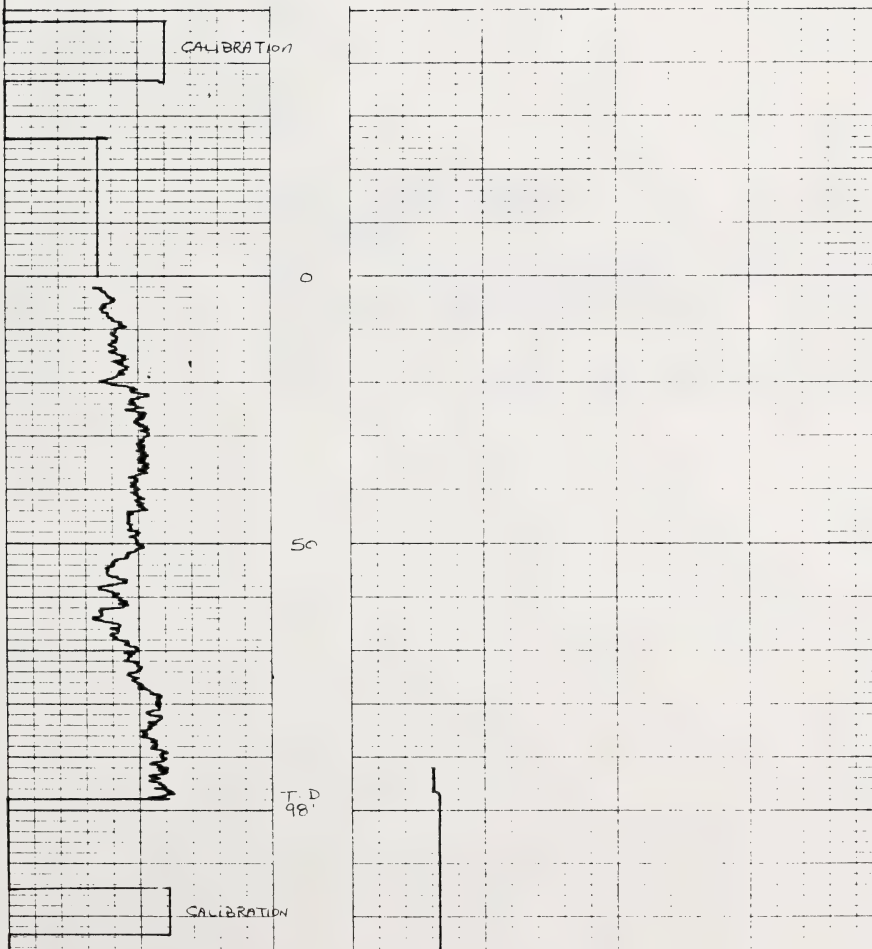
LOCATION _____

LOCATION LSD 9-27-55-12 W4M

NTS MAP REFERENCE 73E/13
Q.L. ELEVATION 1840'

	Run No. 1	Run No. 2	MUD	Run No. 1	Run No. 2
Date	1988-04-20		Nature	NATURAL / lbg qt	
First Reading	98'		Density		
Last Reading	2'		Viscosity		
Footage Logged	96'		Reactivity		
T.D. (Driller)	100'		Circ Temp		
Bit Size	5 7/8"		pH		
Casing Size	5 7/8"				
Interval	0-21				
Bit Size					
Casing Size					
Interval			Logged by	S. Clare	
			Witnessed by	M. Chacabarro	

REMARKS Logging Speed 12'/min.
Time Constant 3 sec.
Calibration 6.1 API



ALBERTA ENVIRONMENT HOLE #2486E
(DUVERNAY #3)
LSD 5-26-55-12W4M

ELEV. 1895' amsl.

DEPTH (feet)	<u>LITHOLOGY</u>
0 - 2	topsoil
2 - 4	sand
4 - 12	sandy brown clay
12 - 24	clay
24 - 39	sand/gravel
39 - 46	sandstone
46 - 59	shale blowhole from 45' 1 igpm
w.l. 13:67 @ 12:15 pm	
13:32 @ 12:16 pm	
13:11 @ 12:17 pm	
11:97 @ 12:23 pm	
11:61 @ 12:25 pm	
11:04 @ 12:36 pm	
10:83 @ 12:51 pm	
10:68 @ 2:22 pm	
59 - 66	shale brown silty
66 - 88	shale brown slightly harder hard at 74'
88 - 90	sandstone
90 - 100	shale with thin sandstone lenses blow hole 1 igpm
100 - 138	shale siltstone dark brown
138 - 146	sandstone hard grey blew hole 1 igpm
146 - 158	shale
172 - 178	shale - siltstone looks like Lea Park Formation.

GEOPHYSICAL LOG		 Alberta ENVIRONMENT EARTH SCIENCES DIVISION GROUNDWATER BRANCH		<input checked="" type="checkbox"/> POINT RESISTANCE <input checked="" type="checkbox"/> SPONTANEOUS POTENTIAL <input type="checkbox"/> NORMAL RESISTIVITY <input type="checkbox"/> GAMMA <input type="checkbox"/> CASING COLLAR LOCATION <input type="checkbox"/> TEMPERATURE GRADIENT <input type="checkbox"/> DELTA TEMPERATURE <input type="checkbox"/> MUD CELL		PROJECT	WELL	LOCATION
OXBRIDGE PLACE 8820-108 ST. EDMONTON, ALBERTA T5K 2J8		PROJECT <u>GROUNDWATER EXPLORATION</u> AREA <u>DUFFERINAY</u> WELL <u>TEST HOLE No 3</u> LOCATION <u>LSD 5-26-55-12 W4M</u>		NTS MAP REFERENCE <u>73E/13</u> G.L. ELEVATION <u>1880'</u>				
	Run No 1	Run No 2	MUD	Run No 1	Run No 2			
Date	1988-04-28		Nature	Natural / 1 kg gel				
First Reading	177'		Density					
Last Reading	3'		Viscosity					
Footage Logged	174'		Resistivity					
T.D. (Driller)	180'		Circ Temp					
Bit Size	6 1/4"		pH					
Casing Size	5 9/16"							
Interval	0-18'							
Bit Size	5 7/8"							
Casing Size	OPEN							
Interval	18-100							
			Logged by	S. Clare				
			Witnessed by	M. Chernawchen				
REMARKS <u>Logging Speed 60' / min.</u>								
S. P. P. R.								
2 mV/CD 5 ~ / CD								
<p>The plot shows two curves on a grid. The left curve represents Spontaneous Potential (S.P.) and the right curve represents Point Resistance (P.R.). The vertical axis is depth in feet, ranging from 0 to 179 feet. The S.P. curve shows a significant negative deflection between 50 and 100 feet depth. The P.R. curve shows a sharp peak at approximately 100 feet depth and another smaller peak at 150 feet depth.</p>								
TD 179'								

GEOPHYSICAL LOG

OXBRIDGE PLACE
9820-108 ST.
EDMONTON, ALBERTA
T5K 2J6

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- ☐ POINT RESISTANCE
- ☐ SPONTANEOUS POTENTIAL
- ☐ NORMAL RESISTIVITY
- ☒ GAMMA
- ☐ CASING COLLAR LOCATOR
- ☐ TEMPERATURE GRADIENT
- ☐ DELTA TEMPERATURE
- ☐ MUD CELL

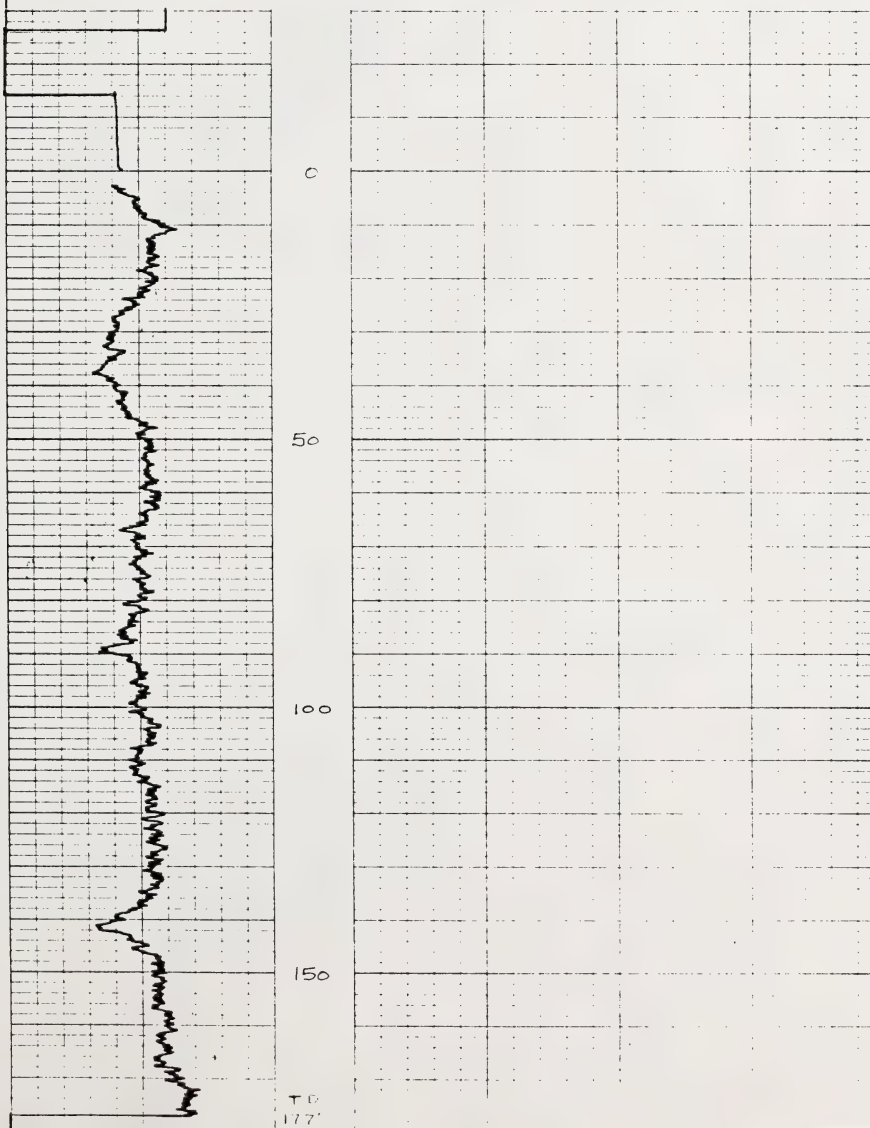
PROJECT _____
WELL _____
LOCATION _____

PROJECT GROUNDWATER EXPLORATION
AREA DUVERNAY
WELL TEST HOLE No. 3
LOCATION LSD 5-26-55-12 W4M

NTS MAP REFERENCE 73E/13
G.L. ELEVATION 1880

	Run No. 1	Run No. 2	MUD	Run No. 1	Run No. 2
Date	1988.04.28		Nature	Natural / 1 b9 qe	
First Reading	177'		Density		
Last Reading	3'		Viscosity		
Footage Logged	174'		Resistivity		
T.D. (Driller)	180'		Circ Temp		
Bit Size	6 1/4"		pH		
Casing Size	5 7/16"				
Interval	0-18'				
Bit Size	5 1/8"				
Casing Size	OPEN				
Interval	18-180'				
			Logged by	S. Glare	
			Witnessed by	My Chetawechan	

REMARKS Logging Speed 12'/min.
Time Constant 3 sec
Calibration 6.1 API



ALBERTA ENVIRONMENT HOLE #2487E
(DUVERNAY #4)
LSD 14-22-55-12W4M

ELEV. 1910' amsl.

<u>DEPTH</u> <u>(feet)</u>	<u>LITHOLOGY</u>
0 - 1	topsoil
1 - 2	boulder
2 - 16	till sandy, pebbly with stones, stone at 2'; light brown oxidized
16 - 20	till sandy grey
20 - 34	till higher sand content grey
34 - 42	till grey
42 - 65	shale dark brown
65 - 79	sandstone, very soft, light grey
79 - 87	sandstone, slightly harder
87 - 89	sandstone, hard
89 - 95	sandstone
95 - 106	sandstone silty
106 - 108	shale
cased hole to 64 feet	
air tested 12-15 igpm for 1.5 hours	
took water sample	
Gamma ray log only	
Sealed hole with Ben Seal	

GEOPHYSICAL LOG

OXBIDGE PLACE
8820-108 ST.
EDMONTON, ALBERTA
T5K 2J6

Alberta
ENVIRONMENT
EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- ☐ POINT RESISTANCE
- ☐ SPONTANEOUS POTENTIAL
- ☐ NORMAL RESISTIVITY
- ☒ GAMMA
- ☐ CASING COLLAR LOCATION
- ☐ TEMPERATURE GRADIENT
- ☐ DELTA TEMPERATURE
- ☐ MUD CELL

PROJECT _____
WELL _____
LOCATION _____

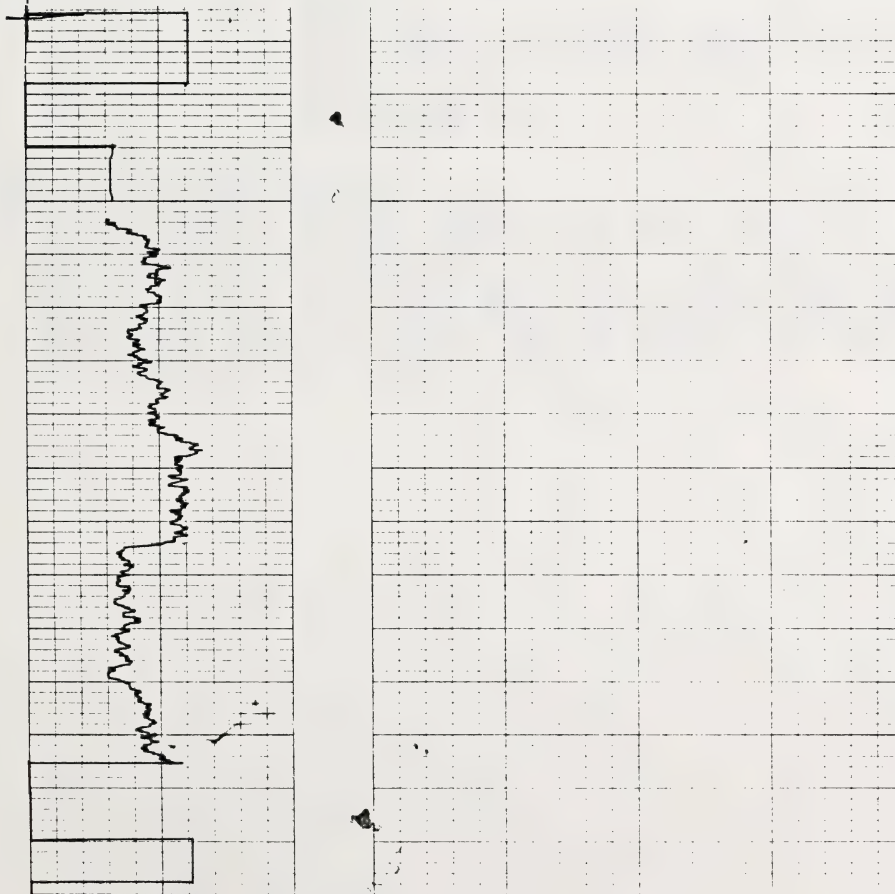
PROJECT GROUNDWATER EXPLORATION
AREA DUVERNAY
WELL TEST HOLE No. 4
LOCATION LSD 14-22-55-12 W4M

NTS MAP REFERENCE 73E/13
G.L. ELEVATION 1910'

	Run No 1	Run No 2	MUD	Run No 1	Run No 2
Date	1988-05-02		Nature	FRESH AQUIFER WATER	
First Reading	105.5'		Density		
Last Reading	3.5'		Viscosity		
Footage Logged	102.0'		Resistivity		
T.D. (Driller)	108'		Circ Temp		
Bit Size	6 1/4"		pH		
Casing Size	5 7/16"				
Interval	0-60'				
Bit Size	5 1/8"				
Casing Size	OPEN				
Interval	60-108'				
			Logged by	S. Clance	
			Witnessed by	M. Chetrowichan	

REMARKS No S.P. or P.R. logs run. Hole had been air tested to
determine aquifer yield.

GAMMA RAY
Logging Speed 12"/min
Tube Constant 3 sec
Calibration 6-1 ADI



ALBERTA ENVIRONMENT HOLE #2488E
(DUVERNAY #5)
LSD 15-22-55-12W4M

ELEV. 1900' amsl.

<u>DEPTH</u> <u>(feet)</u>	<u>LITHOLOGY</u>
0 - 1	topsoil
2 - 14	sandy clay brown till stoney sandy
14 - 18	grey clay till stoney sandy
18 - 40	shale brown silty
40 - 55	shale siltstone
55 - 60	sandstone poorly cemented no cuttings light grey
60 - 80	as above harder from 76' salt & pepper light grey
80 - 88	as above taking water
88 - 95	shale with thin sandstone beds dark brown
95 - 100	shale dark brown
	air test 6 gpm
100 - 116	shale
116 - 122	shale with thin clayey sandstone lenses
122 - 132	sandstone? with shale layers
132 - 140	shale
140 - 160	shale, Lea Park

E-logged - gamma ray: P.R.

Sealed hole with BenSeal

Move rig ahead 10 ft. to install well (Hole #2489E)

case to 55' cemented casing

drill out to 68 ' install 5" stainless steel well screen with
washdown bottom. Jet screen into 12 - 20 seive frac sand.

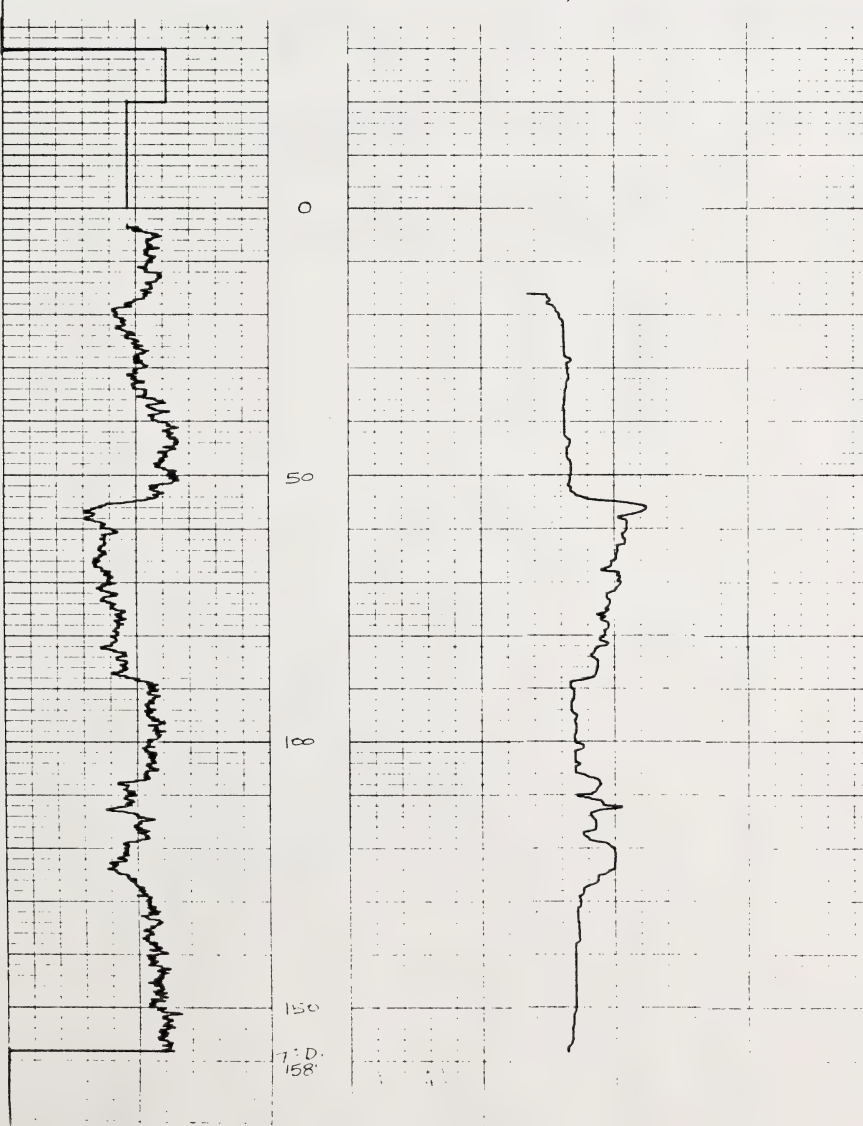
S.W.L. after developing open hole and letting recover for 3/4 hour.
10.4 m from ground surface.

GEOPHYSICAL LOG <small>OXBRIDGE PLACE 9820-108 ST. EDMONTON, ALBERTA T5K 2J6</small>	 Alberta ENVIRONMENT EARTH SCIENCES DIVISION GROUNDWATER BRANCH	<input checked="" type="checkbox"/> POINT RESISTANCE <input type="checkbox"/> SPONTANEOUS POTENTIAL <input type="checkbox"/> NORMAL RESISTIVITY <input checked="" type="checkbox"/> GAMMA <input type="checkbox"/> CASING COLLAR LOCATOR <input type="checkbox"/> TEMPERATURE GRADIENT <input type="checkbox"/> DELTA TEMPERATURE <input type="checkbox"/> MUD CELL	PROJECT _____ WELL _____ LOCATION _____
PROJECT <u>GROUNDWATER EXPLORATION</u> AREA <u>DUVERNAY</u> WELL <u>TEST HOLE NO. 5</u> LOCATION <u>LSD 15-27-55-12W4M</u>		NTS MAP REFERENCE <u>73E/13</u> G.L. ELEVATION <u>1906'</u>	

Date	Gamma	Point Res.	MUD	Run No 1	Run No 2
	Run No	Run No			
First Reading	1988.05.03	1988.05.03	Nature	Natural/164 gal	
Last Reading	158'	158'	Density		
Footage Logged	4'	0'	Viscosity		
T.D. (Driller)	154'	158'	Resistivity		
Bit Size	160"	160"	Circ Temp		
Casing Size	5 1/8"	5 3/8"	pH		
Interval					
Bit Size					
Casing Size					
Interval					
			Logged by	S. Clare	
			Witnessed by	M. Cherniwehan	

REMARKS: No S.P. log. - hole had been compressor tested to determine yield from sandstone from 100 ft, then air drilled to bottom.

GAMMA-RAY Time Constant <u>3 sec.</u> Logging Speed <u>12' / min</u> Calibration <u>6.1 API</u>	POINT RESISTANCE Logging Speed <u>60' / min</u> <u>5 m / 10</u>
---	--



ALBERTA ENVIRONMENT HOLE #2490E
(DUVERNAY #6)
LSD 1-22-55-12W4M

ELEV. 1915' amsl.

<u>DEPTH</u> <u>(feet)</u>	<u>LITHOLOGY</u>
0 - 9	sand fine gravel 8' yellow/orange color
9 - 22	sand
casing set to 22 feet	
22 - 24	sand
24 - 48	siltstone, very silty, almost a sandstone, brown
48 - 87	shale silty dark grey
87 - 107	sandstone poorly cemented light grey
107 - 120	shale silty some cuttings - silty sandstone dark brown
blew hole however it blew out from lots of fine sand then broke the casing seal. Pull stem out. Poured 2 bags Benseal down the outside of the casing to make a casing seal.	
120 - 136	shale silty dark brown
136 - 159	sandstone
159 - 160	shale

Hole electric logged and gamma ray logged and sealed with Benseal.

GEOPHYSICAL LOG

GEOPHYSICAL SERVICE
100-100 ST.
EDMONTON, ALBERTA
T6C 2K6



EARTH SCIENCES DIVISION
GROUNDWATER BRANCH

- ☐ POINT RESISTANCE
- ☐ SPONTANEOUS POTENTIAL
- ☐ NORMAL RESISTIVITY
- ☒ GAMMA
- ☐ CASING POLARIZATION
- ☐ TEMPERATURE LOGGING
- ☐ DRILL TEMPERATURE
- ☐ MUD CELL
- ☐
- ☐

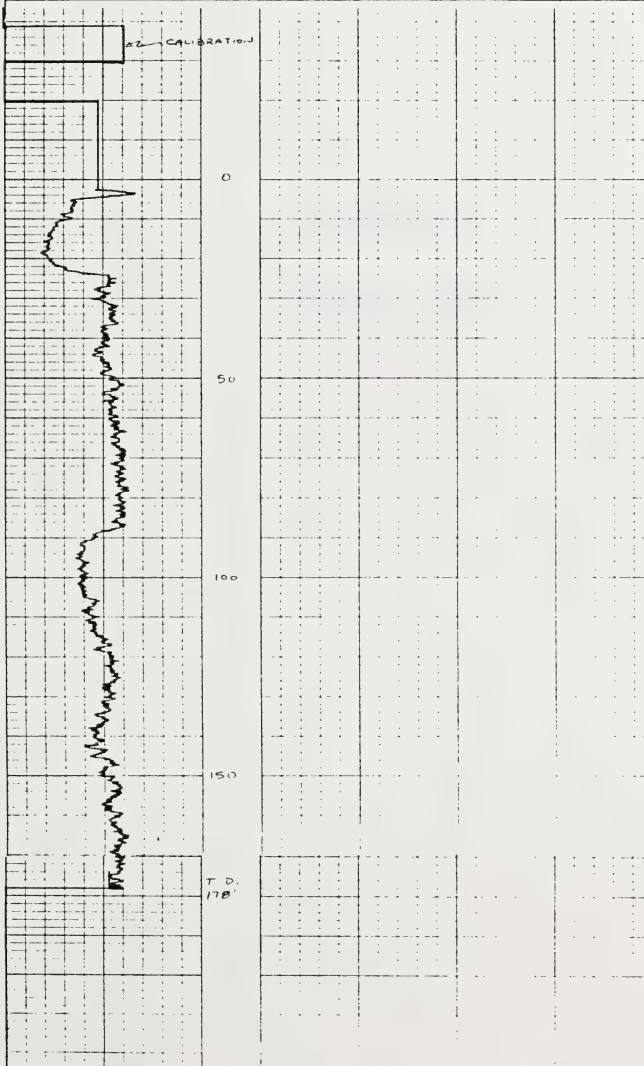
PROJECT _____
WELL _____
LOCATION _____

PROJECT GROUNDWATER EXPLORATION
AREA DUVERNAY
WELL TEST HOLE No. 6
LOCATION LSD 1-22-55-12 W4M

NTS MAP REFERENCE 736/13
O.L. ELEVATION 1115'

	Run No. 1	Run No. 2	MUD	Run No. 1	Run No. 2
Date	1988-05-06		Notes	data 1/1 by gel	
First Reading	198		Fluids		
Last Reading	4		Viscosity		
Footage Logged	194'		Plasticity		
T.O. (Drillbit)	200'		Clay Temp		
Bit Size	6 7/8"		psi		
Casing Size	5 7/8"				
Logwell	0-25'				
Bit Size	5 7/8"				
Casing Size	OPEN				
Interval	27-200'				
			Logged By	S. Clark	
			Witnessed By	M. Chiriac	

REMARKS Logging Speed 12' / min
Line Constant 3 sec
Calibration 6 LAPZ
GAMMA RAY



APPENDIX B

AQUIFER TEST

SITE 5



Earth Sciences Division
Groundwater Branch

Aquifer Test Data

Well No. 2487E Well Owner: Alberta Environment Measured by: S. Clare/M. Cherniychan

Location of project: Duvernay Well location: Lsd. or 1/4 14 Sec. 22 Tp. 55 R. 12 Mer. W. 4

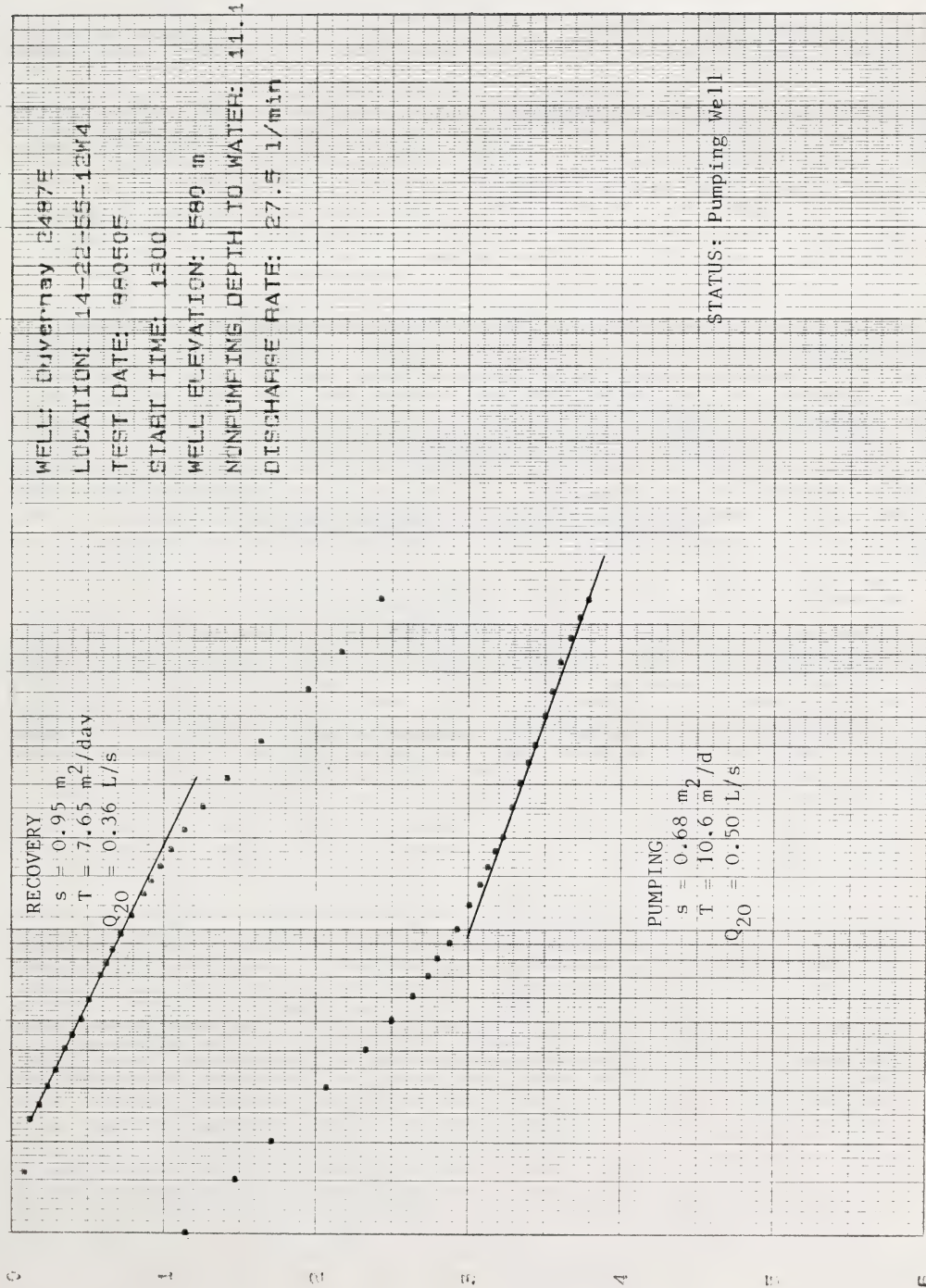
Status: Pumping Well R = (distance from pumping well in feet and direction) Date: May 5, 1988 Page 1

Date	Time hrs. & mins.	Elapsed time in mins. t	Time since pumping stopped t'	t / t'	Depth to water ()	Draw- down ()	Pumping rate q (m ³ /d)	REMARKS (i.e. water temp., static level, weather condition, well completion, etc.)
May 5/88	1:00 p.m.	0			11.11	0		static level
		0.5			11.81	0.70	39.7	6.06 Igpm
		1.0			12.26	1.15		weather - windy 15°C
		1.5			12.59	1.48		
		2			12.83	1.72		
		3			13.19	2.08		
		4			13.45	2.34		
		5			13.62	2.51		
		6			13.76	2.65		
		7			13.86	2.75		
		8			13.92	2.81		
		9			14.00	2.89		
		10			14.05	2.94	39.7	6.06 Igpm
		12			14.13	3.02		
		14			14.20	3.09		conductivity 960 umhos
		16			14.25	3.14	39.7	9 sec per gallon
		18			14.30	3.19		
		20			14.35	3.24		
		25			14.41	3.30	39.7	6.06 Igpm
		30			14.46	3.35		
		35			14.515	3.405		
		40			14.56	3.45		water temperature 6.4°C
		50			14.625	3.515		water sample taken
	2:00 p.m.	60			14.67	3.56	39.7	6.06 Igpm
		75			14.725	3.615		
		90			14.79	3.68	39.7	6.06 Igpm
		105			14.85	3.74		conductivity 950 umhos
	3:00 p.m.	120			14.905	3.795		
		120.5	0.5	241	14.00	2.89	0	
		121	1	121	13.55	2.44		
		121.5	1.5	81	13.29	2.18		
		122	2	61	13.07	1.96		
		123	3	41	12.76	1.65		
		124	4	31	12.54	1.43		
		125	5	25	12.38	1.27		
		126	6	21	12.26	1.15		
		127	7	18.1	12.17	1.06		
		128	8	16	12.10	0.99		
		129	9	14.3	12.04	0.93		
		130	10	13	11.99	0.88		
		132	12	11	11.91	0.80		
		134	14	9.57	11.84	0.73		
		136	16	8.5	11.785	0.675		
		138	18	7.67	11.745	0.635		
		140	20	7	11.705	0.595		
		145	25	5.8	11.63	0.52		
		150	30	5	11.58	0.47		
		155	35	4.4	11.52	0.41		
		160	40	4	11.47	0.36		
		170	50	3.4	11.41	0.30		
	4:00 p.m.	180	60	3	11.355	0.245		pulled pump
		195	75	2.6	11.30	0.19		
		210	90	2.3	11.24	0.13		
	5:30 p.m.	330	210	1.57	11.20	0.09		

AQUIFER TEST

DRAWDOWN:

RECOVERY:



TIME t IN MINUTES AND t/t'

DRAWDOWN AND RECOVERY, DRAWDOWN IN METERS

APPENDIX C

CHEMICAL WATER ANALYSIS REPORT

ENVIRONMENTAL PROTECTION SERVICES
EARTH SCIENCES DIVISION LABORATORY
BAG 3014
COUSINS BUILDING, LETHBRIDGE, ALBERTA
T1J 4B3 PHONE: 329-5322

2056

PLEASE PRINT
FIRMLY

This analysis will contribute to a resource data bank and be available to the public.

Client:

DUVERNAY - 1
(NAME)

.....
(STREET)

(CITY, TOWN, VILLAGE)

.....
(POSTAL CODE)

.....
(TELEPHONE)

Source of Sample: WELL
(STREAM, DUGOUT, WELL, TAP, ETC.)

If Well, Depthmeters, 140 feet, Depth to Water Levelmeters,feet

Well Completion

(DRILLED, DUG, SCREEN, SE

Location 16 ¼ Section 22 Township 55 Range 12 W 4 Meridian

Submitted by (if not client): D. Huculak

Phone

14th FLOOR STANDARD LIFE CENTRE 10405-JASPER AVE
(ADDRESS) (POSTAL CODE) EDMONTON ALTA.

Results to: STEVE CLARE 14TH FLOOR STANDARD LIFE CENTRE 10405-JASPER AVE

Date of Sample: 27/04/58

Sampler's Comments:

Reason for Sample: HUMAN CONSUMPTION

☐

For Interpretation Contact Local Health Unit

LIVESTOCK CONSUMPTION

☐

For Interpretation Contact Local Veterinarian

IRRIGATION

☐

For Interpretation Contact Irrigation Specialist

Analysis

Date Completed May 6/88

EC 1.55

deci Siemens/m

pH 8.40

SAR 20.8

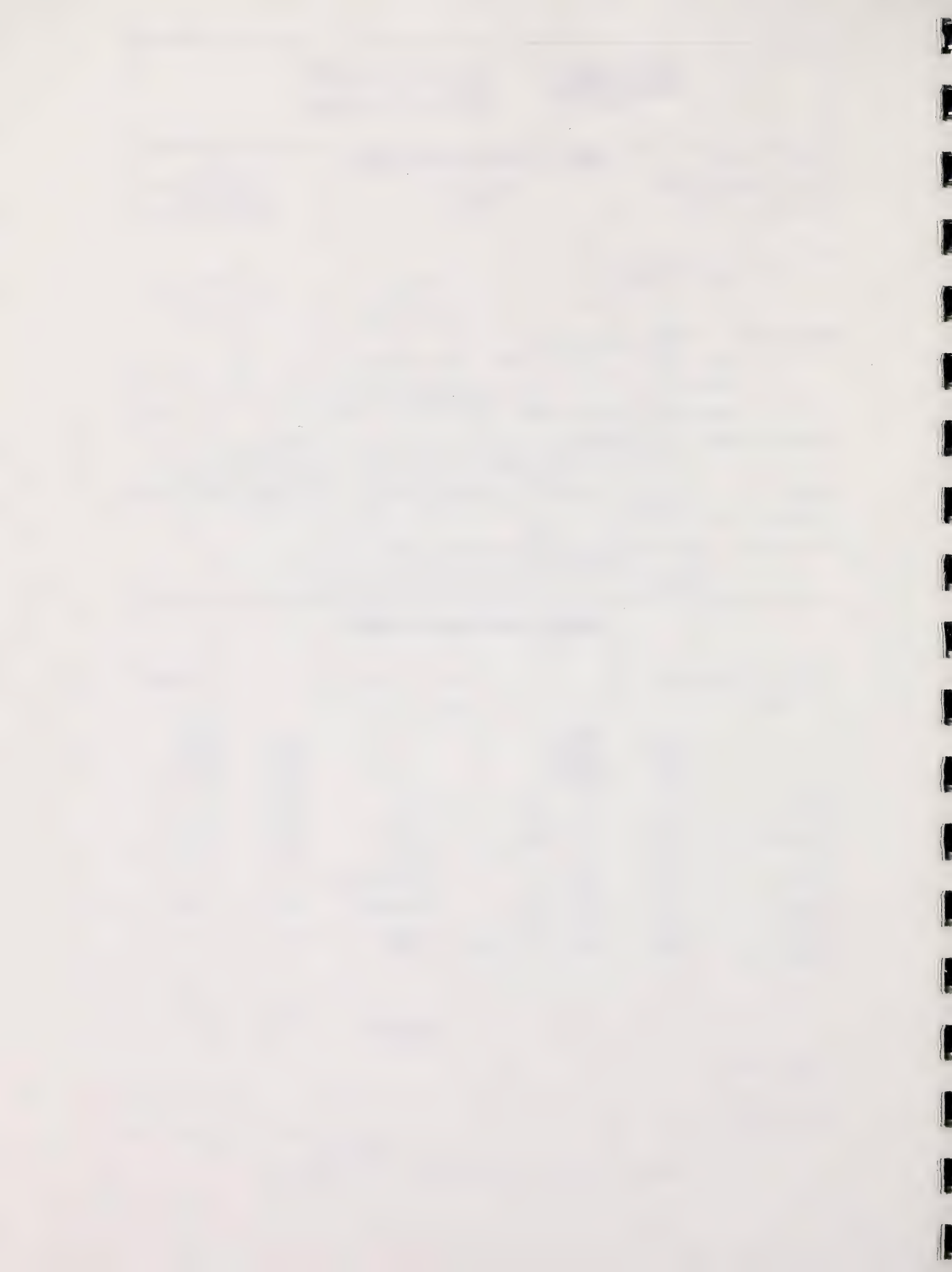
	Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)			Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)	
Calcium	15	N.E.*	Ca	Iron	1.89	0.3	Fe
Magnesium	5	N.E.	Mg	Fluoride	0.71	1.5	F
Hardness, Total	58	N.E.	CaCO ₃	Sulphate	143	500	SO ₄
Sodium	363	N.E.	Na 4270	Chloride	37	250	Cl
Potassium	5	N.E.	K	Nitrate-Nitrogen Plus			
Carbonate	23	N.E.	CO ₃	Nitrite-Nitrogen	6.07	10.0	N
Bicarbonate	762	N.E.	HCO ₃ 4	Ammonium-Nitrogen	1.79	1.0	N
Alkalinity, Total (T. Alk.)	663	N.E.	CaCO ₃ 4500				
				Total Dissolved Solids (TDS)	968	500	

Laboratory Comments:

*NE—Not Established.

FOR
H. F. REGIER
BRANCH HEAD

WHITE - Client; YELLOW - File; BLUE - Hydrogeology Branch; PINK - Municipal Engineering





ENVIRONMENTAL PROTECTION SERVICES
EARTH SCIENCES DIVISION LABORATORY
BAG 3014
COUSINS BUILDING, LETHBRIDGE, ALBERTA
T1J 4B3 PHONE: 329-5322

Lab. No. 219
Date Rec'd May 4, 88
Project Code No. 03

CHEMICAL WATER ANALYSIS REQUEST

PLEASE PRINT
FIRMLY

This analysis will contribute to a resource data bank and be available to the public.

Client:

..... DUVERNAY - 4
 (NAME) (STREET) (CITY, TOWN, VILLAGE)

 (POSTAL CODE) (TELEPHONE)

Source of Sample: WELL
(STREAM, DUGOUT, WELL, TAP, ETC.)

If Well, Depthmeters, 102 feet, Depth to Water Levelmeters,feet

Well Completion

Location 14 % Section 22 Township 55 Range 12 W 4 Meridian

Submitted by (if not client): D. Huculak Phone

(ADDRESS) (POSTAL CODE)

Results to: STEVE CLARK 19TH FLOOR STANDARD LIFE CENTRE 10405-JASPER AVE

Date of Sample: April 29/88 Sampler's Comments: EDIMENTEN FLTA.

Reason for Sample:	HUMAN CONSUMPTION	<input type="checkbox"/>	For Interpretation Contact Local Health Unit
	LIVESTOCK CONSUMPTION	<input type="checkbox"/>	For Interpretation Contact Local Veterinarian
	IRRIGATION	<input type="checkbox"/>	For Interpretation Contact Irrigation Specialist

CHEMICAL WATER ANALYSIS REPORT

Analysis

Date Completed May 6/88 EC 1.51 deci Siemens/m

pH 8.40 SAR 32.6

	Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)		Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)	
Calcium	7	N.E.	Ca	0.01	0.3	Fe
Magnesium	1	N.E.	Mg	0.40	1.5	F
Hardness, Total	24	N.E.	CaCO ₃	168	500	SO ₄
Sodium	363	N.E.	Na	33	250	Cl
Potassium	3	N.E.	K			
Carbonate	19	N.E.	CO ₃			
Bicarbonate	708	N.E.	HCO ₃			
Alkalinity, Total (T. Alk.)	612	N.E.	CaCO ₃	1.01	1.0	N
						N
			Total Dissolved Solids (TDS)	943	500	

Laboratory Comments:

*NE—Not Established.

E.S. _____ FOR

H. F. REGIER
BRANCH HEAD

WHITE – Client; YELLOW – File; BLUE – Hydrogeology Branch; PINK – Municipal Engineering



ENVIRONMENTAL PROTECTION SERVICES
EARTH SCIENCES DIVISION LABORATORY
BAG 3014
COUSINS BUILDING, LETHBRIDGE, ALBERTA
T1J 4B3 PHONE: 329-5322

Lab. No. 236

Date Rec'd May 11/88

Project Code No.03

CHEMICAL WATER ANALYSIS REQUEST

PLEASE PRINT
FIRMLY

This analysis will contribute to a resource data bank and be available to the public.

Client:

Stephen Clare Technical Services
(NAME) (STREET) (CITY, TOWN, VILLAGE)
Hydrocarlog y Bc. 14th Fl Standard bide Edmonton
(CITY, TOWN, VILLAGE) (POSTAL CODE) (TELEPHONE)

Source of Sample: test well not screened 7276189
(STREAM, DUGOUT, WELL, TAP, ETC.)

If Well, Depth 1' meters, 3 feet, Depth to Water Level 1 meters, 3 feet

Well Completion cased off superficial - air lift test on s.s.
(DRILLED, DUG, SCREEN, SETTLING ETC.)

Location 14 ¼ Section 22 Township 55 Range 12 W 4 Meridian

Submitted by (if not client): Phone

Results to: Stephen Clark (ADDRESS) (POSTAL CODE)

Date of Sample: May 2/88 Sampler's Comments: sample taken after

Reason for Sample:

HUMAN CONSUMPTION	<input type="checkbox"/>	For Interpretation Contact Local Health Unit
LIVESTOCK CONSUMPTION	<input type="checkbox"/>	For Interpretation Contact Local Veterinarian
IRRIGATION	<input type="checkbox"/>	For Interpretation Contact Irrigation Specialist

CHEMICAL WATER ANALYSIS REPORT

Analysis

Date Completed May 12/88 EC 1.45 deci Siemens/m

pH 8.07 SAR 26.2

	Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)			Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)	
Calcium	10	N.E.*	Ca	Iron	0.40	0.3	Fe
Magnesium	2	N.E.	Mg	Fluoride	0.10	1.5	F
Hardness, Total	32	N.E.	CaCO ₃	Sulphate	181	500	SO ₄
Sodium	338	N.E.	Na	Chloride	29	250	Cl
Potassium	3	N.E.	K	Nitrate-Nitrogen Plus			
Carbonate	e	N.E.	CO ₃	Nitrite-Nitrogen	50.07	10.0	N
Bicarbonate	659	N.E.	HCO ₃	Ammonium-Nitrogen	1.4	1.0	N
Alkalinity, Total (T. Alk.)	540	N.E.	CaCO ₃				N
				Total Dissolved Solids (TDS)	889	500	

Laboratory Comments:

*NE—Not Established.

..... FOR
H F REGIER
BRANCH HEAD

WHITE - Client; YELLOW - File; BLUE - Hydrogeology Branch; PINK - Municipal Engineering

ENVIRONMENTAL PROTECTION SERVICES
EARTH SCIENCES DIVISION LABORATORY
BAG 3014
COUSINS BUILDING, LETHBRIDGE, ALBERTA
T1J 4B3 PHONE: 329-5322

CHEMICAL WATER ANALYSIS REQUEST

PLEASE PRINT
FIRMLY

This analysis will contribute to a resource data bank and be available to the public.

Client:

Source of Sample:

If Well, Depth 28 meters, 86 feet, Depth to Water Level 16 meters, 32 feet

Well Completion drilled, casing cemented in, 7 slot screen (5') and packed

Location 14 ¼ Section 22 Township 55 Range 12 W 4 Meridian

Submitted by (if not client): Phone

Results to:

Date of Sample: Mar 5/88 Sampler's Comments: _____

Reason for Sample: ☐ HUMAN CONSUMPTION ☐ For Interpretation Contact Local Health Unit

☐ LIVESTOCK CONSUMPTION ☐ For Interpretation Contact Local Veterinarian

☐ IRRIGATION ☐ For Interpretation Contact Irrigation Specialist

CHEMICAL WATER ANALYSIS REPORT

Analysis

Date Completed 11/any 12/88 EC 1.54 deci Siemens/m

pH 8.46 SAR 23.9

	Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)			Sample Results mg/L (ppm)	Canadian Drinking Water Standards mg/L (ppm)	
Calcium	12	N.E.*	Ca	Iron	0.51	0.3	Fe
Magnesium	3	N.E.	Mg	Fluoride	0.68	1.5	F
Hardness, Total	43	N.E.	CaCO ₃	Sulphate	127	500	SO ₄
Sodium	359	N.E.	Na	Chloride	37	250	Cl
Potassium	4	N.E.	K	Nitrate-Nitrogen Plus			
Carbonate	20	N.E.	CO ₃	Nitrite-Nitrogen	40.07	10.0	N
Bicarbonate	722	N.E.	HCO ₃	Ammonium-Nitrogen	1.75	1.0	N
Alkalinity, Total (T. Alk.)	625	N.E.	CaCO ₃				N
				Total Dissolved Solids (TDS)	949	500	

Laboratory Comments:

*NE—Not Established.

..... FOR
H. F. REGIER
BRANCH HEAD
PINK - Municipal Engineering

WHITE – Client; YELLOW – File; BLUE – Hydrogeology Branch; PINK – Municipal Engineering

APPENDIX D

WATER WELL DRILLERS REPORTS

WATER WELL DRILLERS REPORT

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

[illegible]

CERTIFICATION
WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER.

SIGNATURE [Signature]
JOURNEYMAN NO. VA 2321 DATE April 27 19 88

WELL OWNER

ANTICIPATED WATER REQUIREMENT:

_____ GALLONS/LITRES PER DAY

I HAVE RECEIVED A COPY OF THIS REPORT.

SIGNATURE _____

DATE _____ 19____

ALBERTA ENVIRONMENT COPY

WATER WELL DRILLERS REPORT

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

(1) CONTRACTOR		(9) WELL OWNER		(13) LOCATION				
NAME: Alta Environment		NAME: Alta Env. (Bank & B.C.)		1/4	SEC.	TWP.	RGE.	WEST OF MERIDIAN
ADDRESS: 10405 Jasper Ave. Edmonton, Alta		ADDRESS: Duvernay, Alta		9	27	55	12	W4
MEASUREMENTS SPECIFIED IN IMPERIAL <input checked="" type="checkbox"/> OR METRIC <input type="checkbox"/>								
LICENCE NO.: 524		(10) ILLUSTRATION OF WELL CONSTRUCTION		(14) TYPE OF WELL:				
DATE STARTED: April 27 1988		<p>Test hole</p> <p>Test hole approx. 40' W of Highway 36 + approx. 100' N of approach into field.</p> <p>Test hole abandoned with Benseal</p>		NOTARY <input checked="" type="checkbox"/> BORED <input type="checkbox"/> CABLE TOOL <input type="checkbox"/> JET <input type="checkbox"/> DUG <input type="checkbox"/> OTHER <input type="checkbox"/>				
DATE COMPLETED: April 28 1988				(15) TYPE OF WORK:				
WELL COMPLETION DATA				NEW WELL <input type="checkbox"/> DEEPEN <input type="checkbox"/> TEST HOLE <input checked="" type="checkbox"/> RECONDITION <input type="checkbox"/> ABANDON <input type="checkbox"/>				
(2) DESIGN:				(16) PROPOSED USE:				
OPEN HOLE: SLOTTED CASING SCREEN: GRAVEL PACK DIAMETER OF HOLE: BOTTOMED IN: CLAY: SAND SANDSTONE: SHALE: COAL: DEPTH TO TOP OF BEDROCK: TOTAL DEPTH: (3) CASING: TYPE: SIZE O.D.: WALL THICKNESS BOTTOM SET AT: FT/M (4) SEAL: YES <input type="checkbox"/> NO <input type="checkbox"/> DEPTH OF SEAL: FT/M DESCRIPTION:				DOMESTIC <input type="checkbox"/> STOCK <input type="checkbox"/> IRRIGATION <input type="checkbox"/> MUNICIPAL <input type="checkbox"/> INDUSTRIAL <input type="checkbox"/> OBSERVATION <input type="checkbox"/>				
(5) LINER: YES <input type="checkbox"/> NO <input type="checkbox"/>		(11) FORMATION LOG DESCRIPTION		(17) PRODUCTION TEST				
TYPE:		DEPTH		TIME				
SIZE O.D.:		FROM TO		WATER LEVEL WHILE PUMPING FT/M				
WALL THICKNESS		GROUND LEVEL		WATER LEVEL RECOVERY FT/M				
BOTTOM AT: FT/M TOP AT: FT/M		2 12 topsoil		0				
PERFORATED FROM: FT/M TO: FT/M		2 12 weathered ss		30 SEC.				
HOW PERFORATED: TORCH <input type="checkbox"/>		12 19 gr ss / interbedded sh		1 MIN.				
MACHINE <input type="checkbox"/> OTHER <input type="checkbox"/>		19 44 sh		1 MIN. 30 SEC.				
SIZE PERFORATIONS: IN/MM BY: IN/MM		44 47 ss		2 MIN.				
(6) SAND PACK: YES <input type="checkbox"/> NO <input type="checkbox"/>		47 52 sh		3				
SIZE: AMOUNT:		52 59 sh / ss stringer		4				
(7) SCREEN: YES <input type="checkbox"/> NO <input type="checkbox"/>		59 61 sh		5				
MATERIAL:		61 70 ss		6				
SIZE I.D. (CLEAR):		70 99 sh		7				
LENGTH:		Compressor test hole		8				
SLOT SIZE:		Hole prod. approx. 1 gpm		9				
FITTINGS TOP:				10				
FITTINGS BOTTOM:				12				
METHOD OF INSTALLATION:				14				
(8) PUMP: YES <input type="checkbox"/> NO <input type="checkbox"/>				16				
TYPE: H.P.:				18				
SIZE: VOLTAGE:				20				
DROP PIPE SIZE: LENGTH:				25				
MATERIAL:				30				
INHAKE AT: FT/M				35				
				40				
				50				
				60				
				75				
				90				
				105				
				120				
				PUMP <input type="checkbox"/> BAILER <input type="checkbox"/> AIR <input type="checkbox"/>				
				NON-PUMPING WATER LEVEL FT/M				
				RATE OF YIELD I.G.P.M./L.P.M.				
				DURATION OF TEST (MIN 2 HR TEST) HRS. MINS.				
				PUMPING WATER LEVEL OR BAILING LEVEL FT/M				
				TOTAL DRAWDOWN AT END OF TEST FT/M				
				PUMP SET AT FT/M				
				RECOMMENDED PUMPING RATE I.G.P.M./L.P.M.				
				ADDITIONAL PRODUCTION TEST INFO. YES/NO				
				(18) WATER QUALITY:				
				CHEMICAL ANALYSIS YES <input type="checkbox"/> NO <input type="checkbox"/>				
				BACTERIAL ANALYSIS YES <input type="checkbox"/> NO <input type="checkbox"/>				
				WATER TEMPERATURE				
				OTHER				

CERTIFICATION WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER

SIGNATURE: *[Signature]*
JOURNEYMAN NO. VA 3321 DATE: April 28 1988

WELL OWNER

ANTICIPATED WATER REQUIREMENT:

GALLONS/LITRES PER DAY

I HAVE RECEIVED A COPY OF THIS REPORT.

SIGNATURE: _____
DATE: _____ 19 ____

WATER WELL DRILLERS REPORT

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

(1) CONTRACTOR		(9) WELL OWNER		(13) LOCATION				
NAME: <u>Alta. Environment</u>		NAME: <u>Alta. Env. (Western Resources Ltd.)</u>		1/4	SEC.	TWP.	RGE.	WEST OF MERIDIAN
ADDRESS: <u>10405 - Jasper Ave. Edmonton, Alta</u>		ADDRESS: <u>Duvernay, Alta</u>		<u>5</u>	<u>26</u>	<u>55</u>	<u>12</u>	<u>W4</u>
		2486-E						
MEASUREMENTS SPECIFIED IN IMPERIAL <input checked="" type="checkbox"/> OR METRIC <input type="checkbox"/>								
LICENCE NO. <u>524</u>		(10) ILLUSTRATION OF WELL CONSTRUCTION		(14) TYPE OF WELL:				
DATE STARTED <u>April 28 1988</u>		<u>Test hole</u> <u>Test hole approx 200m E of Highway 36 + approx. 500 m N of Highway 639</u> <u>Test hole abandoned with cement</u>		ROTARY <input checked="" type="checkbox"/> BORED <input type="checkbox"/> CABLE TOOL <input type="checkbox"/> JET <input type="checkbox"/> DUG <input type="checkbox"/> OTHER <input type="checkbox"/>				
DATE COMPLETED <u>April 28 1988</u>				(15) TYPE OF WORK:				
WELL COMPLETION DATA				NEW WELL <input type="checkbox"/> DEEPEN <input type="checkbox"/> TEST HOLE <input checked="" type="checkbox"/> RECONDITION <input type="checkbox"/> ABANDON <input type="checkbox"/>				
(2) DESIGN: OPEN HOLE: <u>SLOTTED CASING</u> SCREEN: <u>GRAVEL PACK</u> DIAMETER OF HOLE: BOTTOMED IN: <u>CLAY</u> <u>SAND</u> SANDSTONE <u>SHALE</u> <u>COAL</u> DEPTH TO TOP OF BEDROCK: TOTAL DEPTH:				(16) PROPOSED USE:				
(3) CASING:				DOMESTIC <input type="checkbox"/> STOCK <input type="checkbox"/> IRRIGATION <input type="checkbox"/> MUNICIPAL <input type="checkbox"/> INDUSTRIAL <input type="checkbox"/> OBSERVATION <input type="checkbox"/>				
TYPE				(17) PRODUCTION TEST				
SIZE O.D. WALL THICKNESS				TIME WATER LEVEL WHILE PUMPING FT/M WATER LEVEL RECOVERY FT/M				
BOTTOM SET AT: FT/M				0 30 SEC. 1 MIN. 1 MIN. 30 SEC. 2 MIN. 3 4 5 6 7 8 9 10 12 14 16 18 20 25 30 35 40 50 60 75 90 105 120				
(4) SEAL: YES <input type="checkbox"/> NO <input type="checkbox"/>				PUMP <input type="checkbox"/> BAILER <input type="checkbox"/> AIR <input type="checkbox"/>				
DEPTH OF SEAL: FT/M				NON-PUMPING WATER LEVEL FT/M RATE OF YIELD I.G.P.M./L.P.M. DURATION OF TEST (MIN 2 HR TEST) HRS. MINS. PUMPING WATER LEVEL OR BAILING LEVEL FT/M TOTAL DRAWDOWN AT END OF TEST FT/M PUMP SET AT FT/M RECOMMENDED PUMPING RATE I.G.P.M./L.P.M. ADDITIONAL PRODUCTION TEST INFO. YES/NO				
DESCRIPTION:				(18) WATER QUALITY: CHEMICAL ANALYSIS YES <input type="checkbox"/> NO <input type="checkbox"/> BACTERIAL ANALYSIS YES <input type="checkbox"/> NO <input type="checkbox"/> WATER TEMPERATURE OTHER				
(5) LINER YES <input type="checkbox"/> NO <input type="checkbox"/>								
TYPE								
SIZE O.D.								
WALL THICKNESS								
BOTTOM AT: FT/M TOP AT: FT/M								
PERFORATED FROM: FT/M TO: FT/M								
HOW PERFORATED: TORCH <input type="checkbox"/>								
MACHINE <input type="checkbox"/> OTHER <input type="checkbox"/>								
SIZE PERFORATIONS IN/MM BY IN/MM								
(6) SAND PACK: YES <input type="checkbox"/> NO <input type="checkbox"/>								
SIZE: AMOUNT:								
(7) SCREEN: YES <input type="checkbox"/> NO <input type="checkbox"/>								
MATERIAL:								
SIZE I.D. (CLEAR):								
LENGTH:								
SLOT SIZE:								
FITTINGS TOP:								
FITTINGS BOTTOM:								
METHOD OF INSTALLATION:								
(8) PUMP: YES <input type="checkbox"/> NO <input type="checkbox"/>								
TYPE: H.P.:								
SIZE: VOLTAGE:								
DROP PIPE SIZE: LENGTH:								
MATERIAL:								
INTAKE AT: FT/M								
(12) ELECTRIC LOG YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>								
GAMMA LOG YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>								
(11) FORMATION LOG DESCRIPTION								
DEPTH								
FROM TO								
GROUND LEVEL								
2 4								
4 16								
16 20								
20 39								
39 46								
46 59								
59 79								
79 84								
84 86								
86 93								
93 138								
138 143								
143 148								
148 179								
Compressor tested hole								
Yield approx. 15 gpm.								

CERTIFICATION WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER.

SIGNATURE

JOURNEYMAN NO. VA 3721

DATE

April 28 1988

WELL OWNER

ANTICIPATED WATER REQUIREMENT:

_____ GALLONS/LITRES PER DAY

I HAVE RECEIVED A COPY OF THIS REPORT.

SIGNATURE

DATE

10

WATER WELL DRILLERS REPORT

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

(1) CONTRACTOR NAME: <u>Alta. Environment</u> ADDRESS: <u>10405 Jasper Ave. Edmonton, Alta</u>		(9) WELL OWNER NAME: <u>Alla Env. (W. Hohol)</u> ADDRESS: <u>Duverney, Alta</u>		(13) LOCATION 1/4: <u>14</u> SEC: <u>22</u> TWP: <u>55</u> RGE: <u>12</u> WEST OF MERIDIAN: <u>034</u>																																																																																											
LICENCE NO: <u>524</u> DATE STARTED: <u>Apr. 29</u> 19 <u>88</u> DATE COMPLETED: <u>Apr. 29</u> 19 <u>88</u>		(10) ILLUSTRATION OF WELL CONSTRUCTION <u>Test hole</u> <u>Test hole located approx. 270' W of N-S fence line & approx. 10 S of E-W fence line</u> <u>Test hole abandoned with Benscal</u>		(14) TYPE OF WELL: ROTARY <input checked="" type="checkbox"/> BORED <input type="checkbox"/> CABLE TOOL <input type="checkbox"/> JET <input type="checkbox"/> DUG <input type="checkbox"/> OTHER <input type="checkbox"/>																																																																																											
WELL COMPLETION DATA (2) DESIGN: OPEN HOLE: <input type="checkbox"/> SLOTTED CASING: SCREEN: <input type="checkbox"/> GRAVEL PACK: DIAMETER OF HOLE: BOTTOMED IN: <input type="checkbox"/> CLAY <input type="checkbox"/> SAND: SANDSTONE <input type="checkbox"/> SHALE <input type="checkbox"/> COAL: DEPTH TO TOP OF BEDROCK: TOTAL DEPTH: (3) CASING: TYPE: SIZE O.D. WALL THICKNESS: BOTTOM SET AT: FT/M (4) SEAL: YES <input type="checkbox"/> NO <input type="checkbox"/> DEPTH OF SEAL: FT/M DESCRIPTION:		(11) FORMATION LOG DEPTH DESCRIPTION <table border="1"> <thead> <tr> <th>FROM</th> <th>TO</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td>1</td><td>2</td><td>topsoil</td></tr> <tr><td>2</td><td>16</td><td>gr & clay - boulders</td></tr> <tr><td>16</td><td>42</td><td>sh & hm cl</td></tr> <tr><td>42</td><td>65</td><td>gr cl</td></tr> <tr><td>65</td><td>69</td><td>sh/SS thin layers</td></tr> <tr><td>69</td><td>87</td><td>SS (soft)</td></tr> <tr><td>87</td><td>89</td><td>hd ss ledge</td></tr> <tr><td>89</td><td>95</td><td>SS</td></tr> <tr><td>95</td><td>99</td><td>sh & ss</td></tr> <tr><td>99</td><td>106</td><td>SS</td></tr> <tr><td>106</td><td>109</td><td>sh</td></tr> </tbody> </table>		FROM	TO	DESCRIPTION	1	2	topsoil	2	16	gr & clay - boulders	16	42	sh & hm cl	42	65	gr cl	65	69	sh/SS thin layers	69	87	SS (soft)	87	89	hd ss ledge	89	95	SS	95	99	sh & ss	99	106	SS	106	109	sh	(15) TYPE OF WORK: NEW WELL <input type="checkbox"/> DEEPEN <input type="checkbox"/> TEST HOLE <input checked="" type="checkbox"/> RECONDITION <input type="checkbox"/> ABANDON <input type="checkbox"/>																																																							
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(12) ELECTRIC LOG YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> GAMMA LOG YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>		(18) WATER QUALITY: CHEMICAL ANALYSIS YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> BACTERIAL ANALYSIS YES <input type="checkbox"/> NO <input type="checkbox"/> WATER TEMPERATURE: OTHER:																																																																																													

CERTIFICATION WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER.

SIGNATURE: [Signature]

JOURNEYMAN NO. VA 7321 DATE: Apr. 29 19 88

WELL OWNER

ANTICIPATED WATER REQUIREMENT:

GALLONS/LITRES PER DAY

I HAVE RECEIVED A COPY OF THIS REPORT.

SIGNATURE: _____

DATE: _____ 19 _____

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

(1) CONTRACTOR		(9) WELL OWNER		(13) LOCATION																																																																																									
NAME Alta. Environment		NAME Alta. Env. (L.H. Butcher)		1/4	SEC.	TWP.	RGE.	WEST OF MERIDIAN																																																																																					
ADDRESS 10405 Jasper Ave. Edmonton, Alta		ADDRESS Duvernay, Alta		15	22	55	12	W4																																																																																					
MEASUREMENTS SPECIFIED IN IMPERIAL <input checked="" type="checkbox"/> OR METRIC <input type="checkbox"/>																																																																																													
LICENCE NO. 524		(10) ILLUSTRATION OF WELL CONSTRUCTION		(14) TYPE OF WELL:																																																																																									
DATE STARTED May 3 1988		<p>Well located approx. 25' S of E-W line line approx. 20' W of N-S line</p> <p>Lead pkr @ 50'</p> <p>5 1/2" cas. 4 1/2" riser, 4 1/2" cas. - screen 62' - 67.5'</p> <p>1-5/8" slotted 4" screen 62'-67.5'</p> <p>Well down from @ 68'</p>		ROTARY <input type="checkbox"/> BORED <input type="checkbox"/> CABLE TOOL <input type="checkbox"/> JET <input type="checkbox"/> DUG <input type="checkbox"/> OTHER <input type="checkbox"/>																																																																																									
DATE COMPLETED May 5 1988				(15) TYPE OF WORK:																																																																																									
WELL COMPLETION DATA				NEW WELL <input checked="" type="checkbox"/> DEEPEN <input type="checkbox"/> TEST HOLE <input type="checkbox"/> RECONDITION <input type="checkbox"/> ABANDON <input type="checkbox"/>																																																																																									
(2) DESIGN:				(16) PROPOSED USE:																																																																																									
OPEN HOLE: SLOTTED CASING:		DOMESTIC <input type="checkbox"/> STOCK <input type="checkbox"/> IRRIGATION <input checked="" type="checkbox"/>																																																																																											
SCREEN: GRAVEL PACK:		MUNICIPAL <input type="checkbox"/> INDUSTRIAL <input type="checkbox"/> OBSERVATION <input checked="" type="checkbox"/>																																																																																											
DIAMETER OF HOLE: 5 1/2"		(17) PRODUCTION TEST (PUMPING AT A CONSTANT RATE)																																																																																											
BOTTOMED IN: CLAY: SAND:		<table border="1"> <thead> <tr> <th>TIME</th> <th>WATER LEVEL WHILE PUMPING (F.T.)</th> <th>WATER LEVEL RECOVERY (F.T.)</th> </tr> </thead> <tbody> <tr><td>0</td><td>11.11</td><td></td></tr> <tr><td>30 SEC.</td><td>11.81</td><td>14.00</td></tr> <tr><td>1 MIN.</td><td>12.26</td><td>12.55</td></tr> <tr><td>1 MIN. 30 SEC.</td><td>12.59</td><td>13.29</td></tr> <tr><td>2 MIN.</td><td>12.83</td><td>13.07</td></tr> <tr><td>3</td><td>13.19</td><td>12.76</td></tr> <tr><td>4</td><td>13.48</td><td>12.54</td></tr> <tr><td>5</td><td>13.62</td><td>12.38</td></tr> <tr><td>6</td><td>13.76</td><td>12.26</td></tr> <tr><td>7</td><td>13.86</td><td>12.17</td></tr> <tr><td>8</td><td>13.92</td><td>12.10</td></tr> <tr><td>9</td><td>14.00</td><td>12.04</td></tr> <tr><td>10</td><td>14.05</td><td>11.99</td></tr> <tr><td>12</td><td>14.13</td><td>11.91</td></tr> <tr><td>14</td><td>14.20</td><td>11.84</td></tr> <tr><td>16</td><td>14.25</td><td>11.785</td></tr> <tr><td>18</td><td>14.30</td><td>11.745</td></tr> <tr><td>20</td><td>14.35</td><td>11.705</td></tr> <tr><td>25</td><td>14.41</td><td>11.63</td></tr> <tr><td>30</td><td>14.47</td><td>11.58</td></tr> <tr><td>35</td><td>14.515</td><td>11.52</td></tr> <tr><td>40</td><td>14.56</td><td>11.47</td></tr> <tr><td>50</td><td>14.625</td><td>11.41</td></tr> <tr><td>60</td><td>14.67</td><td>11.355</td></tr> <tr><td>75</td><td>14.725</td><td>11.30</td></tr> <tr><td>90</td><td>14.77</td><td>11.24</td></tr> <tr><td>105</td><td>14.85</td><td>210 min = 11.20</td></tr> <tr><td>210</td><td>14.905</td><td></td></tr> </tbody> </table>					TIME	WATER LEVEL WHILE PUMPING (F.T.)	WATER LEVEL RECOVERY (F.T.)	0	11.11		30 SEC.	11.81	14.00	1 MIN.	12.26	12.55	1 MIN. 30 SEC.	12.59	13.29	2 MIN.	12.83	13.07	3	13.19	12.76	4	13.48	12.54	5	13.62	12.38	6	13.76	12.26	7	13.86	12.17	8	13.92	12.10	9	14.00	12.04	10	14.05	11.99	12	14.13	11.91	14	14.20	11.84	16	14.25	11.785	18	14.30	11.745	20	14.35	11.705	25	14.41	11.63	30	14.47	11.58	35	14.515	11.52	40	14.56	11.47	50	14.625	11.41	60	14.67	11.355	75	14.725	11.30	90	14.77	11.24	105	14.85	210 min = 11.20	210	14.905	
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SANDSTONE: SHALE: COAL:		PUMP <input checked="" type="checkbox"/> BAILER <input type="checkbox"/> AIR <input type="checkbox"/>																																																																																											
DEPTH TO TOP OF BEDROCK: 19'		NON-PUMPING WATER LEVEL 11.11 F.T.																																																																																											
TOTAL DEPTH: 68'		RATE OF YIELD 6 G.P.M. P.M.																																																																																											
(3) CASING:		DURATION OF TEST (MIN 2 HR TEST) 2 HRS 0 MINS.																																																																																											
TYPE: Steel insert		PUMPING WATER LEVEL OR BAILING LEVEL 3.795 F.T.																																																																																											
SIZE O.D. 5 9/16 WALL THICKNESS .188		TOTAL DRAWDOWN AT END OF TEST 3.795 F.T.																																																																																											
BOTTOM SET AT: 54.5 F.T.M.		PUMP SET AT 55 F.T.M.																																																																																											
(4) SEAL: YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>		RECOMMENDED PUMPING RATE 6 G.P.M. P.M.																																																																																											
DEPTH OF SEAL: 54.5 F.T.M.		ADDITIONAL PRODUCTION TEST INFO. YES <input checked="" type="checkbox"/>																																																																																											
DESCRIPTION Cemented csg. dm		Not at time of drilling																																																																																											
Surface to 54.5'		(18) WATER QUALITY:																																																																																											
(5) RISER PIPE		CHEMICAL ANALYSIS YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>																																																																																											
TYPE: Steel insert		BACTERIAL ANALYSIS YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>																																																																																											
SIZE O.D. 4 1/2"		WATER TEMPERATURE 6.55°C																																																																																											
WALL THICKNESS .156		OTHER																																																																																											
BOTTOM AT: 62 F.T.M. TOP AT: 50 F.T.M.		WELL OWNER																																																																																											
PERFORATED FROM 2 F.T.M. TO 55 F.T.M.		ANTICIPATED WATER REQUIREMENT:																																																																																											
Riser pipe 10' 4 1/2" csg. - screen adaptor (2')		GALLONS/LITRES PER DAY																																																																																											
HOW PERFORATED: 3000 <input type="checkbox"/>		I HAVE RECEIVED A COPY OF THIS REPORT.																																																																																											
MACHINE <input type="checkbox"/> OTHER <input type="checkbox"/>		SIGNATURE																																																																																											
SIZE PERFORATIONS: IN/IN BY: IN/IN		DATE																																																																																											
(6) SAND PACK: YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>		JOURNEYMAN NO. VA 3221 DATE May 5 1988																																																																																											
SIZE 12-20 AMOUNT: 4 gal.		ALBERTA ENVIRONMENT COPY																																																																																											
(7) SCREEN: YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>																																																																																													
MATERIAL: Stainless steel																																																																																													
SIZE I.D. (CLEAR): 4"																																																																																													
LENGTH: 5'																																																																																													
SLOT SIZE: 7																																																																																													
62 F.T.M. 67.5 F.T.M.																																																																																													
FITTINGS TOP: Riser pipe - lead pkr. - csg. - screen																																																																																													
FITTINGS BOTTOM: Well down from csg. - screen																																																																																													
METHOD OF INSTALLATION: Attached to well down from																																																																																													
hole in drill casing																																																																																													
(8) PUMP: YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>																																																																																													
TYPE: H.P.																																																																																													
SIZE: VOLTAGE																																																																																													
DROP PIPE SIZE: LENGTH:																																																																																													
MATERIAL:																																																																																													
INTAKE AT: FT/M																																																																																													
(12) ELECTRIC LOG YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>																																																																																													
GAMMA LOG YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>																																																																																													

CERTIFICATION
WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER.

SIGNATURE *[Signature]*
JOURNEYMAN NO. VA 3221 DATE May 5 1988

WATER WELL DRILLERS REPORT

THIS REPORT TO BE SUBMITTED
WITHIN 60 DAYS AFTER WELL
COMPLETION TO:

DIRECTOR OF EARTH SCIENCES
ALBERTA ENVIRONMENT

(1) CONTRACTOR NAME: <u>Alta Environment</u> ADDRESS: <u>10405 - Jasper Ave.</u> <u>Edmonton, Alta</u>		(9) WELL OWNER NAME: <u>Alta Env. (L.H. Butcher)</u> ADDRESS: <u>Duverney, Alta</u>		(13) LOCATION 1/4: <u>1</u> SEC: <u>22</u> TWP: <u>55</u> RGE: <u>12</u> WEST OF MERIDIAN: <u>W4</u>																																																																																								
MEASUREMENTS SPECIFIED IN IMPERIAL <input checked="" type="checkbox"/> OR METRIC <input type="checkbox"/>																																																																																												
LICENCE NO: <u>524</u> DATE STARTED: <u>May 4 1988</u> DATE COMPLETED: <u>May 5 1988</u> WELL COMPLETION DATA (2) DESIGN: OPEN HOLE: <input type="checkbox"/> SLOTTED CASING SCREEN: <input type="checkbox"/> GRAVEL PACK DIAMETER OF HOLE: BOTTOMED IN: <input type="checkbox"/> CLAY <input type="checkbox"/> SAND SANDSTONE <input type="checkbox"/> SHALE <input type="checkbox"/> COAL DEPTH TO TOP OF BEDROCK: TOTAL DEPTH: (3) CASING: TYPE: SIZE O.D.: <u>WALL THICKNESS:</u> BOTTOM SET AT: <u>FT/M</u> (4) SEAL: YES <input type="checkbox"/> NO <input type="checkbox"/> DEPTH OF SEAL: <u>FT/M</u> DESCRIPTION:		(10) ILLUSTRATION OF WELL CONSTRUCTION <u>Test hole</u> <u>Test hole abandoned with</u> <u>Removal</u> <u>Test hole approx. 250' W of</u> <u>Highway 26 - approx. 50' E of</u> <u>N-S fence line on west side</u> <u>of gravel pit.</u>		(14) TYPE OF WELL: ROTARY <input checked="" type="checkbox"/> BORED <input type="checkbox"/> CABLE TOOL <input type="checkbox"/> JET <input type="checkbox"/> DUG <input type="checkbox"/> OTHER <input type="checkbox"/> (15) TYPE OF WORK: NEW WELL <input type="checkbox"/> DEEPEN <input type="checkbox"/> TEST HOLE <input checked="" type="checkbox"/> RECONDITION <input type="checkbox"/> ABANDON <input type="checkbox"/> (16) PROPOSED USE: DOMESTIC <input type="checkbox"/> STOCK <input type="checkbox"/> IRRIGATION <input type="checkbox"/> MUNICIPAL <input type="checkbox"/> INDUSTRIAL <input type="checkbox"/> OBSERVATION <input type="checkbox"/> (17) PRODUCTION TEST (PUMPING AT A CONSTANT RATE) <table border="1"> <thead> <tr> <th>TIME</th> <th>WATER LEVEL WHILE PUMPING FT/M</th> <th>WATER LEVEL RECOVERY FT/M</th> </tr> </thead> <tbody> <tr><td>0</td><td></td><td></td></tr> <tr><td>30 SEC.</td><td></td><td></td></tr> <tr><td>1 MIN.</td><td></td><td></td></tr> <tr><td>1 MIN. 30 SEC.</td><td></td><td></td></tr> <tr><td>2 MIN.</td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td></tr> <tr><td>12</td><td></td><td></td></tr> <tr><td>14</td><td></td><td></td></tr> <tr><td>16</td><td></td><td></td></tr> <tr><td>18</td><td></td><td></td></tr> <tr><td>20</td><td></td><td></td></tr> <tr><td>25</td><td></td><td></td></tr> <tr><td>30</td><td></td><td></td></tr> <tr><td>35</td><td></td><td></td></tr> <tr><td>40</td><td></td><td></td></tr> <tr><td>50</td><td></td><td></td></tr> <tr><td>60</td><td></td><td></td></tr> <tr><td>75</td><td></td><td></td></tr> <tr><td>90</td><td></td><td></td></tr> <tr><td>105</td><td></td><td></td></tr> <tr><td>120</td><td></td><td></td></tr> </tbody> </table>		TIME	WATER LEVEL WHILE PUMPING FT/M	WATER LEVEL RECOVERY FT/M	0			30 SEC.			1 MIN.			1 MIN. 30 SEC.			2 MIN.			3			4			5			6			7			8			9			10			12			14			16			18			20			25			30			35			40			50			60			75			90			105			120		
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120																																																																																												
(5) LINER: YES <input type="checkbox"/> NO <input type="checkbox"/> TYPE: SIZE O.D.: WALL THICKNESS: BOTTOM AT: <u>FT/M</u> TOP AT: <u>FT/M</u> PERFORATED FROM: <u>FT/M</u> TO: <u>FT/M</u> HOW PERFORATED: <input type="checkbox"/> TORCH <input type="checkbox"/> MACHINE <input type="checkbox"/> OTHER <input type="checkbox"/> SIZE PERFORATIONS: <u>IN/MM</u> BY: <u>IN/MM</u> (6) SAND PACK: YES <input type="checkbox"/> NO <input type="checkbox"/> SIZE: <u>AMOUNT:</u> (7) SCREEN: YES <input type="checkbox"/> NO <input type="checkbox"/> MATERIAL: SIZE I.D. (CLEAR): LENGTH: SLOT SIZE: <u>FT/M</u> <u>FT/M</u> FITTINGS TOP: FITTINGS BOTTOM: METHOD OF INSTALLATION:		(11) FORMATION LOG DESCRIPTION <table border="1"> <thead> <tr> <th>DEPTH</th> <th>FROM</th> <th>TO</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td></td><td>GROUND LEVEL</td><td>9</td><td>gr</td></tr> <tr><td></td><td>9</td><td>19</td><td>sd</td></tr> <tr><td></td><td>19</td><td>39</td><td>slty ss</td></tr> <tr><td></td><td>39</td><td>48</td><td>slty ss</td></tr> <tr><td></td><td>48</td><td>50</td><td>slty</td></tr> <tr><td></td><td>50</td><td>87</td><td>sh</td></tr> <tr><td></td><td>87</td><td>99</td><td>ss</td></tr> <tr><td></td><td>99</td><td>115</td><td>ss</td></tr> <tr><td></td><td>115</td><td>119</td><td>sh</td></tr> <tr><td></td><td>119</td><td>139</td><td>sh / ss / rhy</td></tr> <tr><td></td><td>139</td><td>156</td><td>ss</td></tr> <tr><td></td><td>156</td><td>170</td><td>sh</td></tr> </tbody> </table>				DEPTH	FROM	TO	DESCRIPTION		GROUND LEVEL	9	gr		9	19	sd		19	39	slty ss		39	48	slty ss		48	50	slty		50	87	sh		87	99	ss		99	115	ss		115	119	sh		119	139	sh / ss / rhy		139	156	ss		156	170	sh																																			
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	139	156	ss																																																																																									
	156	170	sh																																																																																									
(8) PUMP: YES <input type="checkbox"/> NO <input type="checkbox"/> TYPE: <u>H.P.</u> SIZE: <u>VOLTAGE:</u> DROP PIPE SIZE: <u>LENGTH:</u> MATERIAL: INTAKE AT: <u>FT/M</u>		(12) ELECTRIC LOG YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> GAMMA LOG YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> (18) WATER QUALITY: CHEMICAL ANALYSIS: YES <input type="checkbox"/> NO <input type="checkbox"/> BACTERIAL ANALYSIS: YES <input type="checkbox"/> NO <input type="checkbox"/> WATER TEMPERATURE: OTHER:																																																																																										

CERTIFICATION WATER WELL DRILLER (OPERATOR)

THIS WELL WAS CONSTRUCTED UNDER MY DIRECT SUPERVISION AND ALL INFORMATION GIVEN IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF. A COPY OF THIS REPORT HAS BEEN SUPPLIED TO THE OWNER.

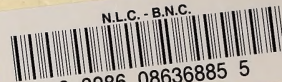
SIGNATURE: [Signature]
 JOURNEYMAN NO. 1A3321 DATE May 5 1988

WELL OWNER

ANTICIPATED WATER REQUIREMENT:
 GALLONS/LITRES PER DAY
 I HAVE RECEIVED A COPY OF THIS REPORT.

SIGNATURE: _____
 DATE: _____ 19__

N.L.C. - B.N.C.



3 3286 08636885 5